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SACRED PHILOSOPHY

OF THE

SEASONS;

ILLUSTRATING

THE PERFECTIONS OF GOD

IN THE

PHENOMENA OF THE YEAR.

BY THE

REV. HENRY DUNCAN, D.D.,

RUTHWELL.

SPRING.

Lo! The winter is past; the rain is over and gone; the flowers appear on the earth: the time of the singing of birds is come, and the voice of the turtle is heard in our land.'—Song of Solomon.

NEW YORK:

ROBERT CARTER & BROTHERS,

No. 530 BROADWAY.

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'I come! I come! Ye have called me long,
I come o'er the mountains with light and song!
Ye may trace my step o'er the wakening earth,
By the winds which tell of the violet's birth,
By the primrose stars in the shadowy grass,
By the green leaves opening as I pass.'—

MRS. HEMANS

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THE present Volume is one of a series, the object of which is to demonstrate the existence and the attributes of God, in the various phenomena of the revolving year. Each volume contains an argument complete in itself, and peculiar to the season of which it treats. The present exibits proofs of the Divine agency in the reproductive powers and processes of creative things, with reference to the qualities of the atmosphere, the diffusion of light and heat, the deposition and distribution of moisture, the properties of the soil, the nature of the living principle, the development of seeds and plants, the animal structure and instincts, &c., &c. A similar arrangement is adopted in this Volume as in that on 'WINTER,' the argument commencing with the consideration of the arrangements and adaptations of inorganic matter, and thence proceeding from the lowest to the highest orders of organized existences, through the various genera of plants and animals.

The latter part of the Volume is devoted to an exemplification of those adaptations and properties in the soil,

and in vegetable substances, which give rise to, and reward the labours of the agriculturist, and which thus lay the foundation of civilized society, and afford a stimulus to progressive improvement in the arts and sciences.

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SACRED PHILOSOPHY OF THE SEASONS.

SPRING.

FIRST WEEK—MONDAY.

GENERAL CHARACTER OF SPRING IN TEMPERATE CLIMATES.

SPRING has been celebrated in glowing terms by the poets of all ages; but in the climate of Britain, if we count the season by the calendar, the weather is by no means so mild and delightful, especially in the early part of this quarter of the year, as it has been painted. In Greece and Rome, indeed, which were the birth-places and nurseries of European poetry, the temperature of the air, the pure blue of the sky, the soft green of the opening leaves, the thousand delicate tints of the flowers scattered so profusely over hill and valley, with the perfume which they exhale, and the music poured from every grove—all unite to fill every sense with enjoyment. *There*, the descriptions of the enraptured muse are true to nature, and the inhabitants of such latitudes feel that the language of poetry is only a transcript of their own sensations. But it is not so in more northern climates, such as our own. Our bards, indeed, equally kindle and burn when SPRING is their theme; but they often glow with a borrowed warmth. Their taste and fancy, having been moulded by the Greek and Latin authors, almost unconsciously transport them to the classic ground from which their models drew their images, causing them to breathe, as it were, the same atmosphere, and to luxuriate in the same delicious climate.

It would be more gratifying to the acumen of the critic, than pleasing to the feelings of the man of taste, to examine how much of the language and imagery of our national poetry, relative to Spring, is drawn from classic ages and classic scenery, and then to estimate what remains of direct inspiration poured into the soul, in this changeable and backward climate, from our own earth, and sea, and sky. I have no relish for such an inquiry, though it seems to be almost forced on the mind, in comparing the 'ethereal mildness' and balmy sweets which breathe in Spring, as portrayed by the British Muse, with our actual experience of a British atmosphere, and of the vernal productions of a British soil. The real Spring of our climate can scarcely be said to be fairly set in, at least in the northern division of the island, till the commencement of summer.

In the month of February, winter not only lingers but rages. Our rivers, ponds, and lakes, are often still either rigidly bound in icy chains, or only partially disengaged from them; and, in some respects, the severity of the climate is frequently even more intense than during winter itself. Sometimes the tempest howls with redoubled fury, driving broad flakes of snow through the darkened air, and encumbering the wide earth with its drifted heaps; and, while the herds on the low grounds stand forlorn and destitute of food, the flocks on the hills are in danger of finding a sudden grave at the bottom of the precipice, whither they have fled for shelter. At other times, the cold and sleety rain falls in torrents, carrying along with it the snow which it has melted in the mountains, and spreading dismay and ruin over the inundated valleys; and, at other times again, the hoar-frost lies thick and chill, and spreads its snowy mantle over hedge and field, while the deep blue sky, and the sun rising in the glowing east, without a cloud, speak deceitfully of to-morrow's softness and beauty.

But notwithstanding the rigours of the climate, there are not wanting, even at the commencement of the season, interesting proofs of the advancing year, and harbingers of a more genial season. The day has already encroached on the long

and dreary night, and the sun takes daily a wider circuit in the heavens. The buds of many trees and flowers have begun to swell; the catkins of the hazel and willow throw their tiny but elegant forms on the sight. The anemonies are in flower in our gardens; and the crocus,

> ——— The first gilt thing
> That wears the trembling pearls of spring,

spreads its cloth of gold on the sheltered borders, along with the hepatica and the white butter-bur; and most interesting of all, the snow-drop, which had for weeks burst through the rigid soil, has now opened its chaste and delicate blossoms to the chilly breeze, and seems to vie in whiteness with the winding-sheet of winter, from which it derives its name.

> 'Already now the snow-drop dares appear,
> The first pale blossom of the unripened year;
> As Flora's breath, by some transforming power,
> Had changed an icicle into a flower;
> Its name and hue the scentless plant retains,
> And winter lingers in its icy veins.'*

Among the feathered tribes, the rooks are beginning to obey the first law of Nature, and their incessant notes of enjoyment, mingled with the bustle of preparation for the important duties of incubation, every where attract the attention of the lovers of Nature. The croaking raven, led by a congenial instinct, selects some venerable tree where she may build her nest, and the sweet songs of the woodlark and chaffinch, mixed with the mellow tones of the blackbird and thrush, from the neighbouring groves, delight the ear; while the wren, the red-breast, the titmouse, and the hedge-sparrow, flutter from spray to spray, and utter their varied notes of gladness, as the sun sheds his warmer rays on wood and field, giving the promise of approaching mildness and fertility. 'Turkey cocks now strut and gobble; partridges begin to pair; the house pigeon has young; field-crickets open their holes, and

* Mrs. Barbauld.

wood-owls hoot; gnats play about, and insects swarm under sunny hedges; the stone-curlew clamours, and frogs croak.'*

These indications are observed in Britain towards the end of February; and, as Spring advances, more unequivocal symptoms of awakening Nature daily appear. The sun continues longer above the horizon, and the weather, though still unsettled, is sufficiently dry to evaporate the superabundant moisture, poured on the earth at the commencement of the season in the form of rain or snow, and thus to favour the various processes of vegetable life which are in active operation, while it prepares the soil for the labours of the husbandman.

The animal tribes now find a delicious repast in the sweet and tender herbage, which begins to clothe our sheltered valleys with its soft verdure; and, among the innumerable sources of enjoyment which this most interesting of all the seasons affords, perhaps there is none that sheds so sweet a pleasure over the benevolent mind, as the universal gladness which, as the weather becomes more genial, sensibly pervades every thing that lives. There is a kind of mysterious sympathy which seems to pass from tribe to tribe of the animated world, and to unite them all in one common hymn of gratitude and praise to the bountiful Giver of all good. The lowing of the cattle as they luxuriate in the green fields; the bleating of the sheep from the heath-clad hills, while their new-dropt lambs sport around them, exulting in the consciousness of young existence; the hum of the industrious bees, as they fly from flower to flower collecting their sweet food; and the varied notes of love and joy, pouring from bush and brake, all unite in one harmonious and spirit-stirring chorus. Nay, inanimate Nature itself seems conscious of the general joy—and as the sun breaks forth from the April shower, every blade of grass sparkles in his beams, wood and mead smile, and the very silence of the clear heavens and swelling earth utters the voice of enjoyment.

* Howitt's Book of the Seasons.

The gradual progress of Spring indicates beneficent design. There is an obvious and studied preparation conducive to the salubrity both of animal and vegetable life. Were the change from winter to spring to be sudden, the constitution of organized existences, such as we find it in our own latitude, would receive so violent an impulse, as would be attended with many injurious consequences. There is here, therefore, a wise adaptation; but the proper way of viewing it is, not so much to consider the climate adapted to these existences, as them to the climate. There are necessarily great varieties of climates from the equator to the arctic circle, and, in them all, we discover a most admirable fitting of the produce and living inhabitants to the conditions of their respective localities; insomuch, that changes, which would utterly destroy the plants and animals of one climate, only tend to give vitality and health to those of another. For example, we have stated that fatal effects would ensue in our own climate, were the alteration from winter to spring to be sudden; and yet nothing can easily be conceived more rapid than the change of temperature from intense cold to genial warmth, in Siberia and other regions verging on the polar circle; and there the conditions of the animal and vegetable world are such, that the violent impulse is just what was required to bring them hastily into life, and enable them quickly to fulfil ther various functions, during their few and fleeting weeks of summer. In the whole economy of Nature, there is scarcely any thing more worthy of remark, as indicating a designing cause, than this species of adaptation, by which the powers of life are suited to the varying conditions of climate. There is, indeed, something extremely satisfactory, as well as peculiar, not only in this respect, but in the whole plan of creation, exhibiting as it does so much uniformity, combined with such variety,—a uniformity as to general design, which might even be supposed to indicate poverty of invention, were it not for the amazing skill with which that general design is modified and altered, so as to be rendered suitable to change of circumstances and conditions,—the former by its strict anal-

ogy, marking unequivocally One contriving Mind,—the latter by its endless variety, displaying the all-pervading wisdom and beneficence of unwearying energy and never exhausted resources.

FIRST WEEK—TUESDAY.

THE INCREASING TEMPERATURE OF THE WEATHER, AND ITS EFFECTS.

When we observe the earth gradually exchanging its winter robes for a mantle of the liveliest green, the flowers springing up in fresh luxuriance at our feet, and every shrub and tree putting forth its buds, which are soon to be beautifully expanded into blossoms and leaves, our first feelings are those of wonder and delight at the marvellous change produced in the general aspect of Nature; and we then naturally seek to contemplate the causes of such a universal transition. By what agency, we ask, does the vegetable world suddenly start from apparent death into all the beauty and exuberance of another spring? What cause, under the direction of the Great Ruler of the year, works the magnificent effect?

The means by which this sudden burst of vegetation is produced, are, like most of the other great agencies of Nature extremely simple. It is merely the increased temperature of the earth and atmosphere, assisting the natural tendency of the plants to awake from the lethargic state into which they are thrown during winter. The progress of the earth in its orbit towards its aphelion, or greatest distance from the sun, causes that luminary to ascend higher in the heavens, and to be longer above the horizon, and thus produces longer and warmer days. It is a well-known physical fact, formerly noticed, that the more perpendicularly the sun's rays fall upon the surface of the earth, the greater is the heat they excite Hence, as the sun, in his northward progress in the ecliptic daily ascends higher above the horizon, and consequently

darts his rays upon our hemisphere in a more perpendicular direction, the temperature of the earth and air gradually increases, and milder and more genial weather ensues. The effect upon the economy of vegetables is more or less rapid, according to their different structures; but in no long period the increased and increasing heat produces a universal development of foliage and flowers. The earth opens, as it were, her bosom to the sun; all her veins feel the genial influence; and a vital energy moves and works in all her blossoms, buds, and leaves. What was lately barrenness becomes fertility; from desolation and death start up life and varied beauty, as if beneath the reviving footsteps of a present Deity. Hence result all the beautiful and amazing phenomena of spring.

As it is a general property of heat to expand all bodies, so the fibrous and cellular substance, of which vegetables are mainly composed, is now subjected to a gradual expansion; and hence the sap ascends from the roots through the innumerable minute tubes and cells in the trunks and branches, and circulates through the finest veins of the leaves and flowers. There is a curious species of attraction, in virtue of which the sap of plants, and liquids in general, ascend through tubular substances, in seeming contradiction to the law of gravity. It is called *capillary* attraction, that is, the attraction of hairs, from the hair-like smallness of the tubes in which its effects are greatest and most visible. Its very remarkable phenomena are not yet satisfactorily accounted for; nor have its laws been fully investigated. It has been clearly ascertained, however, that the ascent of liquids is high in proportion to the fineness of the tubes through which they rise. Now, as the tubes of plants are perhaps the finest that exist, the effects of capillary attraction are more striking in trees than in any other substances; for in them the liquid iuices frequently ascend to a height of more than a hundred feet, and circulate to the extremities of their largest branches and leaves.

It may be difficult to say how much of this process is

merely mechanical, and how much depends on that mysterious property,—the living principle; but there can be no doubt that heat, by promoting the ascent of the sap in plants, is the great external agent in vegetation. It increases in intensity by degrees; and its excessive accumulation is frequently checked by atmospheric changes. Herein is the highest designing wisdom. To recur to a remark yesterday incidentally made, were a summer temperature immediately to succeed the cold of winter, many of our plants would be greatly injured, if not totally destroyed. Their delicate vessels and cells would burst by a too sudden expansion, and the bud, prematurely thrust forth into the light and heat of day, would wither and fall off, or remain an abortive excrescence on its parent stem. We should also be deprived of the beauty and interest attached to the gradual development of leaf and flower, were the great annual transition in the vegetable world effected instantaneously.

In the average winter temperature of our climate, most of our shrubs and trees remain asleep, and without vegetation. But as, in the advancing season, the temperature increases, one plant after another, according to the sensibility of its buds, and other peculiarities of its structure, sends forth its tender shoots and leaves, in beautiful succession, till every field, and garden, and grove, is teeming with beauty and perfume. When once a plant has begun to put forth its foliage, and its vegetation has received a momentum, as it were, from the action of the solar heat, it will bear a temperature considerably below its *vegetating point*, without being much injured or wholly checked in its growth, provided that temperature be not of too long continuance. Here again is beneficent arrangement; for, were it otherwise with plants, we should frequently see the beauty of the forest and the field blasted by a single night's frost.

There is a striking analogy between the vegetative effects of the daily increasing temperature of this season, and the well-known influence of climate upon the geographical distribution of plants. From the first dawn of spring, before

the chillness of winter has left the air to the commencement or middle of autumn, when the year is beginning to wane, flower succeeds flower, and tree after tree comes into leaf, in regular succession. So, also, from the polar circle to the equator, race after race of vegetable forms appears, ascending from the lichens of Lapland to the spice trees of the Tropics. In our gardens, as the temperature of the atmosphere rises, come successively the snow-drop, the crocus, the auricula, the polyanthus, and, in their season, the rest of the splendid train of flowers. In the forest, the willow and the hazel bud earliest in the year; then follow the larch, the beech, the plane, the oak, and the ash; and soon all the sylvan scenery is one verdant mass of leaves. These pleasant successions have their parallels in each hemisphere. To take the northern, in which we dwell, we find in the remote arctic coasts of Europe and America, only mosses, lichens, ferns, and a few diminutive creeping plants and shrubs. As we advance southward, appear the various species of firs and pines, which, again, are closely succeeded by the oak, the elm, the lime, the beech, and other forest trees; and, among fruit trees, by the apple, the pear, the plum, and the cherry. More southward still, flourish the vine and the olive, the lemon, the fig, and the orange,—fruit trees of a richer and more delicate description; and, intermingling with these, grow the cyprus, the cork, the cedar, and the mulberry. Of cereal plants, wheat extends from the 60th degree of latitude to the neighbourhood of the tropics. Oats, barley, and rye, endure a greater degree of cold; but none of these are found to arrive at perfection within the tropics, except upon elevations several thousand feet above the level of the sea. Within the Torrid Zone, maize and rice begin to be cultivated. As we approach the equator, the vegetable productions of the earth increase in richness and luxuriance. In the tropical regions, we meet with the finest fruits and aromatics, and all the plants that most administer to the luxury of man. There flourish the sugar-cane, the coffee-tree, the bread-tree, the palm, the date, the cocoa, the cinnamon, the nutmeg, the pepper, the camphor-tree, and nu-

merous other vegetable treasures. Thus, between the arctic circle and the equator, we have every variety of vegetation, as in each of the intermediate regions there are, annually, beautiful successions of trees, shrubs, and flowers. And how can we withhold our admiration from the matchless skill of the Creator, when we consider that all the lovely variety of the phenomena of our spring, and all the benefits accruing to commerce and civilization, from the present varied distribution of plants, are made simply to depend on modifications of the solar heat? Hence, among other joyful recurrences, the sweet return of spring, and all the delights that intervene between the appearance of the earliest sprout and the full glories of summer vegetation; and hence the marvellous diversity of aspect, assumed by the vegetable world between the equator and the poles. What surprising, and beneficent, and varied effects! The cause, how grand and simple! But need we wonder at this, seeing it is but in accordance with all the operations of the Great Supreme. J. D.

FIRST WEEK—WEDNESDAY.

THE COLOUR AND FIGURE OF BODIES.

The admirable variety which we have seen to obtain over all Nature, may be said chiefly to consist of diversities in the colour, size, and figure of bodies. We have formerly adverted to the enjoyments and advantages that accrue from this variety; and here it may not be improper to dwell a little on the subject of colour and figure, the sources of so much utility and beauty. The term colour has two distinct significations. It may merely express that feeling of the mind which accompanies the sensation produced by any coloured object in our organs of sight; or it may denote the peculiar quality of that object, in virtue of which it excites in the mind a certain feeling, or perception of colour. Colour, however, is generally used in this latter meaning, expressing a particular quality of

bodies; and it is in this popular sense that we would here understand the term.

We cannot open our eyes, and cast an observant glance upon Nature, without being struck with the beautiful and varied phenomena of colour. The fields, the woods, the mountains, the sky, and the ocean, are tinged with a thousand different hues. Whence proceed all those splendid tints that give such variety and beauty to the drapery of Nature? Are they ideal creations of the mind? Do they exist merely in the eye?—or are they truly qualities of matter? To these questions the answer is, that, instead of being any of these exclusively, they result rather from a series of beautiful adaptations. First, every beam of light, as was discovered by Sir Isaac Newton, consists of seven distinct kinds of rays, all fitted to produce different colours; next, the surfaces of all bodies are so constituted, as to reflect one or other, all or none, of these classes of rays, or sometimes a mixture of several, or different proportions of them all; and, again, the eye is so exquisitely formed, as to be differently affected by the various kinds of reflected rays, and thus to be the faithful organ of the mind in discriminating between them, and thereby giving rise to all the delights of vision. The rays of colour, taking them in the order of their refrangibility, and beginning with the most refrangible, are violet, indigo, blue, green, yellow, orange, and red. One body absorbs all the rays but the green, which it reflects, and is consequently green. Another reflects the red rays, absorbing all the rest, and is red. An entire unrefracted beam is white; and when a body absorbs all the component rays, there is a negation of colour, that is, it is black. A body seldom reflects one of the prismatic colours solely and exclusively; but a greater or less proportion of another, or even of several, is commonly reflected along with it. In this way we can account for the endless diversity of hues that result from the seven primary colours; for the proportions in which the several rays may be reflected together are indefinitely numerous. We can only conjecture the cause of bodies reflecting one class of rays, and absorbing

others, so as to appear to our eye of a certain colour. It probably consists in a peculiar arrangement of their minute particles. This arrangement may be destroyed by mechanical or chemical agency, which will account for the changes of colour in bodies exposed to the weather, or to any chemical action. The process of dyeing is only the spreading over the surface of one body the particles of another of a different colour, which, however, can scarcely be effected without producing some chemical change in the dyed substance. The rays of light which, in solid bodies, hardly penetrate the surface, are reflected or absorbed by the dyeing matter, and the original colour of the body is consequently lost.

Colours are spread over all Nature with exquisite beauty and adaptation. The earth is clothed with a mantle of delightful green, interspersed with the more brilliant hues of shrubs, trees, and flowers. In point of refrangibility, green holds the middle place between the two extremes of violet and red. Neither too dark nor too bright, on it the eye, when wearied with livelier or more sombre colours, delights to repose. Were the earth's surface of a black colour, it would be distressing even to look upon, as the eye and mind are at present constituted. Or were white the prevailing hue, our eyes would be dazzled with excessive brightness, and would turn away from all objects with pain and weariness. The colour of the sky is a deep blue, contrasting pleasingly with the soft green of the earth. The blueness of the sky may be caused by the particles of air, and the minute globules of moisture, constantly floating among them, reflecting the blue rays; or it may result from the circumstance, that, of all the rays reflected from the earth into the atmosphere, the blue being most refracted, have the least momentum, and are consequently more liable to be reflected back to the eye. Nor is variety of hue wanting in the regions of the air. Clouds of almost all colours and varieties of tinge, frequently move before the delighted eye, like the splendid scenes of a vast theatre. The sparkling lustre of universal sunshine, the lurid glare of the thunder-cloud, the crimson streaks of

morning, and the rich and ever-varying glories of sun-set, successively solicit our admiration and delight. Yet the eye would tire even of these, if of continual occurrence; and hence the prevailing hue which has been chosen is the pure azure of the unclouded atmosphere, or the sombre shade of the rain-cloud.

The colour of the ocean varies considerably with local circumstances. Its generic colour is dark blue, but in different places it is green, red, or yellow. Various causes may be assigned for the discoloration of the oceanic waters. The nature of the bottom, the weeds and insects upon the surface, the substances and solutions discharged into them by large rivers, all contribute to affect their colour. But the prevailing hues of the ocean are dark and cool, which are at once pleasant and refreshing to the eye, even when accustomed to them, during the months of a long voyage. Yet the ocean is often strewn with wreaths of foam, and has its vast billows crested with white, and rolling in dreadful beauty to the shore. And the foamy whiteness of its agitation is not without its use, independent of its variety and grandeur; for it points out to the voyager the existence of danger, warns him of the approaching storm, and discovers to his distant eye the hidden reef or shoal, and the breakers of a rocky coast.

The variety of Nature depends still more upon the figure of bodies than upon their colour. Figure is an essential property of matter. All bodies, and even the elementary particles of which common substances—the familiar objects of sight and touch—are composed, must, from their very nature, be extended in space, and possess length, breadth, and thickness, which have been termed the limits of extension. We can scarcely conceive of bodies as masses of matter extended in space, without also thinking of their property of figure; because figure is the inevitable result of limited extension, and may, indeed, be defined to be the shape or appearance any body presents from its occupying a certain quantity of space in certain directions.

Figure is almost as varied as the productions and pheno-

mena of Nature are numerous. In the vast and in the minute world, its diversity is equally striking and apparent. We can conceive no bounds to its diversity, which, in reality is as infinite as number or quantity. The forms which matter has assumed upon our globe, defy computation; and how shall we pretend to estimate, or even to conceive, what forms it is capable of assuming?

Figure is either symmetrical or irregular. In the productions of Nature there is usually a symmetry and regularity of form, which can hardly escape the most unpractised eye. Who does not observe, or, observing, is insensible to, the effect of the graceful curved lines that prevail in the animal and vegetable worlds, or of the symmetrical angular forms assumed by minerals and crystals? The property of figure in bodies is the source of half the pleasure we enjoy in our intercourse with Nature. It is of itself a fountain of beauty. It equally seizes the attention of the lover of scenery and the naturalist; is as efficient in exciting pleasing emotions when perceived in the harmonious and beautiful landscape, in the rain-cloud, the hail, the dew, or the snow, as in the graceful form of a flower, or the wreathings of a shell.

It is a curious subject of reflection, that, however great may be the diversity of figure at present existing among solid bodies, yet, in certain specifiable circumstances, they would all assume a globular form. When we contemplate the visible universe, we discover it to consist of an innumerable collection of spheres; and what is true of the suns and satellites that adorn the firmament, has also been proved true of our earth. We know, therefore, the forms which the vast bodies that fill the infinitude of space have assumed, on being hurled from the hand of their Creator. But we also know what form a body would assume in empty space, provided only the cohesive attraction of its component particles were so subdued as to allow gravitation to act freely. It is more than probable that all solids might be reduced to a liquid state. Their cohesion has only to be overcome by heat to a certain extent, and they become fluids. Now, fluids, as they fall through

space, are invariably transformed into globules. The phenomena of rain, and of molten lead let fall from a height, are well known instances of this, and require no description.

Difference of size is another element of the variety of Nature. The distinction between size and figure is natural and obvious. If bodies of the same figure be of different sizes, all the effect of variety is produced. The variety of the heavenly bodies, for example, as seen from the earth, is chiefly that of size. Size, or magnitude, it is evident, is only relative. One body may be large in relation to another, but insignificantly small in relation to a third. What is the loftiest mountain-peak compared to the earth, and the earth compared to the sun? Yet that peak is a world relatively to a grain of its sand. In Nature we see an infinite diversity of the magnitudes of bodies, from the sun, that is the centre and life of numerous worlds, down to the mote that flickers in one of his beams. And when, setting out from the opposite extremes of magnitude that come within the reach of our perception, we attempt to measure its ascending and its descending scale, and to find a limit to the vast and the minute, we utterly fail in our efforts; and even imagination itself is overpowered. So illimitable in both directions is the universe of God.

Thus, whatever is the property of material substances, be it essential or merely contingent, that comes under our observation, we find in it Divine benevolence and wisdom. The colours, figures, and sizes of bodies are infinitely varied, and thereby is the earth agreeably diversified and adorned.

J. D.

FIRST WEEK—THURSDAY.

MOUNTAINS.

Few objects in Nature have a sublimer aspect than a chain of lofty mountains before they have recovered from the effects of wintry storms. Disrobed of their summer verdure, and

lifting their bare summits in the chilly air, or clad in a mantle of drifted snow, they seem to be the chosen haunts of desolation, the wild abode of darkness and storm. Crowned with no ancient forests, and unadorned with human dwellings, unfurrowed by the plough, incapable of cultivation, and but scantily clothed with a poor and stunted herbage, these vast eminences might at first sight appear almost useless features in the general landscape,—not without their majesty and grandeur, indeed, in the day of storm or of sunshine, yet unprofitably encroaching upon the beauty and fertility of the plain.

But experience and research have unfolded to us the great advantages of mountains. Were it only because they are the sources of springs and rivers, we have ample reason to feel grateful for their existence. Their vast masses attract the clouds, and receive, in the form of rain, hail, or snow, the vapours with which the atmosphere is charged, even when the plains below are parched with summer drought; and hence the irregular and mountainous surface of the earth is veined over with a multitude of rills, and brooks, and rivers, whose waters, by a wonderful species of circulation, flow to the place whence they came,—that mighty and ever-heaving heart, the ocean. Were the earth a dead level, or even slightly varied with hillocks or gentle ascents, the moisture that should fall would be gathered into turbid and sluggish streams, or stagnant lakes, and the whole surface of the ground, more than saturated, would become a vast marsh, sending forth noxious exhalations, pregnant with disease and death. All animal and vegetable life would languish; cultivation could scarcely exist; and, instead of a scene of rich and varied beauty, we should only behold a cheerless mixture of land and water. All the advantages attributed to rivers, might with greater propriety be ascribed to the mountains that produce and nourish them. Let us take one example of a mighty and fertilizing river, the Nile. Whence flow those famous waters, that, after a long and mysterious course, scatter golden harvests over the vale of Egypt? They descend from the Abyssinian

and Nubian mountains, and are fed by their melted snows, and by the abundant tropical rains. Their remotest springs may be yet undiscovered, but these also are doubtless formed in the bosom of the Ethiopic hills.

Mountains exercise a considerable, and, upon the whole, a salutary influence upon climate. Independently of the effect of the streams and rivers which they originate and send forth, to promote at once the fertility and salubrity of the champaign country, these elevated ranges, by intercepting the clouds, or by changing the currents of wind, so as to cause them to mingle, generally occasion that deposition of moisture, which, in its different forms, is called mist or rain, and which is so necessary to water the earth, and make it fruitful. We are screened from cold northerly blasts and from parching winds, by mountains, the bulwarks Nature has reared to shield her valleys and plains. In countries near the poles, their presence affords a protection from the cold; and in the tropical regions they mitigate the solar heat, or afford a shelter from its influence. They form one of the many great arrangements made to equalize the temperature of the earth's various climates. In their southern slopes, we find on the grandest scale bright sunny exposures, on which, even in the higher latitudes, flourish the grape, the olive, and other delicious fruits. On mountains, also, we frequently find all the climates of the earth, varying according to the elevation, and the consequent rarity and coldness of the air. In the lofty tropical ranges, every clime, with its peculiar productions, is met with, between the burning plains at their basis, and their summits capped with eternal snow. Thus, the Alps, the Andes, and the Himmalayahs, present every variety of stern and luxuriant scenery, and, though rising in the regions of perpetual summer, bear on their summits the plants and flowers of the polar circles. The number of valuable simples found only on mountains, also recommend to our gratitude these vast terraces of Nature In the extensive forests that frequently enrobe them, or on their bare rocks unshielded

from the chilling air, grow the rarest and most useful vegetables, botanical curiosities, or of medicinal virtue.

Mountains are likewise almost the sole repositories of minerals. In their cavernous bowels are discovered the various metals that are so invaluable to man, and so necessary to the arts of civilization.* The grains of gold sometimes found in the sand of rivers, are but stray treasures, rolled down from their native hills. These great mineral storehouses are sometimes up-torn by subterranean fires, and burst forth into terrible volcanoes. But may not the volcano, destructive and awful as it frequently is, be but a safety-valve for the escape of those sulphurous and nitrous fires generated in the shell of the earth; and which, if they found not vent through the chimneys and furnaces of mountain-peaks, might so accumulate in quantity and force, as to tear up and consume entire kingdoms? The innumerable particles of sulphur and nitre, evolved from volcanic fires, are scattered by the winds over the whole atmosphere, and fall upon the earth, where

* 'Had the earth's surface presented only one unvaried mass of granite or lava, or had its nucleus been surrounded by concentric coverings of stratified rocks, like the coats of an onion, a single stratum only would have been accessible to its inhabitants; and the varied intermixtures of limestone, clay, and sandstone, which, under the actual disposition, are so advantageous to the fertility, beauty, and habitability of the globe, would have had no place.

'Again, the inestimably precious treasures of mineral salt and coal, and of metallic ores, confined, as these latter chiefly are, to the older series of formations, would, under the more simple arrangement of strata, have been wholly inaccessible, and we should have been destitute of all these essential elements of industry and civilization. Under the existing disposition, all the various combinations of strata, with their valuable contents, whether produced by the agency of fire, or by mechanical or chemical deposition beneath the water, have been raised above the sea, to form the mountains and the plains of the present earth: and have still further been laid open to our reach, by the exposure of each stratum, along the sides of valleys.

'With a view to human uses, the production of a soil fitted for agriculture, and the general dispersion of metals, more especially of that most important metal, iron, were almost essential conditions of the earth's habitability by civilized man.'—*Buckland's Bridgewater Treatise*, vol. i. p. 98.

they contribute greatly to the sustenance of plants and animals.

Need I speak of the scenic grandeur of mountains? of the variety, the sublimity, the lofty beauty they throw over the earth's surface, which, but for their presence, would be a dull and undiversified plain? The ocean is not always calm and smooth, but has its mighty billows, ascending to the clouds and rolling to the distant shore; so the land is not a continued and uniform level, but is crowned and beautified with mountains, that stretch over continents their longitudinous arms, and lift their hardy tenants into the higher regions of the air. No landscape is perfect without mountains in the fore-ground, or in perspective. They form the noblest and most enchanting attribute of scenery.

The *moral* effects of mountains are of a peculiar, and even national, interest. Mountains have in all ages been the nurseries of patriotism, the abodes of industry, frugality, patience, and every hardy virtue. The rugged mountaineer, buffeted, but fostered and strengthened, by the storm, and gaining a scanty subsistence as a hunter, or as a tiller of the bleak and rocky soil, is not only a striking and picturesque personage in the eye of the painter or the poet; but, when his country summons her children to battle, or when foreign invasion threatens his dwelling, his heart is bold and his arm is strong in the cause of freedom and independence. Often, in the front of the fight, have mountaineers won pre-eminence in warlike prowess; often, from their native precipices, have they hurled defiance and defeat on the invading foe. Mountain chains, possessed and guarded by their bold inhabitants, are the best barriers against external danger, and the securest asylum of persecuted freedom. And frequently, in the history of the Church, have the afflicted followers of the Saviour found refuge in mountain tracts, where, in wild dens and caves of the earth, they have worshipped the God of their fathers, concealed from the tyrant and the oppressor.

Mountains may impede our rapid progress from place to place, and throw great obstacles in the way of our inland

conveyance; but the more we consider their structure and functions, the more forcibly are we impressed with their peculiar uses and advantages. Here, again, are we called upon to admire the unfathomable wisdom and power of the Creator, whose contriving hand has so wonderfully adapted even the barren mountain to the physical condition of the earth, and the exigencies of man. The solid land, and the restless ocean, with all their variety of aspect and scenery proclaim His goodness. His praise ascends from the naked precipice as well as the smiling valley. All is replete with the wisdom and energy of Him who founded the earth, and 'stretched out the heavens like a curtain,' who weighed the 'mountains in scales, and the hills in a balance.'

J. D.

FIRST WEEK—FRIDAY.

RAIN.

Among the various analogies of Nature, so curious and so diversified, may be ranked that of the circulation of fluid substances. The blood circulates in animals, the sap in plants, and, on a larger scale, the air and the waters of the vast ocean circulate between the equator and the poles, while another species of circulation is created by the combined action of these two elements, which is exhibited in the various phenomena of clouds and rain, and of springs and rivers.

The earth is surrounded with an atmosphere of air, and into this another atmosphere, namely, that of water, in the form of vapour, is introduced by evaporation. These two atmospheres are mingled together in such proportions, that the aerial part always greatly exceeds the aqueous,—the latter varying in weight from about a hundredth, perhaps to a twentieth part of the former. Mr. Whewell, in his Bridgewater Treatise, has very ingeniously shown, that the different laws by which these two fluids are regulated, though, on account

of the complicated nature of their relations, their effects can not always be distinctly traced, are yet such as can be demonstrated, in various particulars, to manifest the most remarkable proofs of wise arrangement, the one modifying and adjusting the other, so as to contribute to the subsistence of vegetable, and the enjoyment of animal, life. It is not consistent with our plan to go deeply into this subject; but the general view taken in the work alluded to, and by other writers on natural phenomena, may be mentioned in a few words. Were the atmosphere to consist entirely of aqueous vapour, the difference of heat in various latitudes, from the equator to the poles, would cause the vapour generated in the former regions to be more rare and elastic than that produced in the latter and intermediate climates; and this difference would create a constant circulation between these extreme points. The sky of the equatorial zone would be perpetually cloudless; but in all other latitudes we should, from the intermixing of the warm with the cold vapour, have 'an uninterrupted shroud of clouds, fogs, rains, and, near the poles, a continual fall of snow,'—'an excessive circulation of moisture, but no sunshine, and, probably, only minute changes in the intensity and appearances of one eternal drizzle or shower.' This state of things would plainly be altogether unfavourable to vegetable and animal life; but the addition of an aerial atmosphere changes the condition, and by its agreement with the atmosphere of vapour in some particulars, and its disagreement, and even direct opposition, in others, so regulates and modifies the whole machinery of the weather, as to render it salubrious. 'The alternations of fair weather and showers, appear to be much more favourable to vegetable and animal life, than any uniform course of weather could have been. To produce this variety, we have two antagonist forces, by the struggle of which such changes occur. Steam and air, two transparent and elastic fluids, expansible by heat, are in many respects and properties very like each other. Yet the same heat, similarly applied to the globe, produces at the surface, currents of these fluids, tending in opposite directions. And these cur-

rents mix and balance, conspire and interfere, so that our trees and fields have alternately water and sunshine, our fruits and grain are successively developed and matured. Why should such laws of heat and elastic fluid so obtain, and be so combined? Is it not in order that they may be fit for such offices? There is here an arrangement which no chance could have produced. The details of this apparatus may be beyond our power of tracing; its springs may be out of sight. Such circumstances do not make it the less a curious and beautiful contrivance. They need not prevent our recognizing the skill and benevolence which we *can* discover.'*

But besides the difference of heat and cold in different latitudes, there is a similar variation in the higher and lower strata of the atmosphere in the very same localities. The air becomes rapidly colder, as well as lighter, in proportion to its height above the general surface of the earth; and this gives rise to other phenomena. The temperature of the air, as it increases in altitude, diminishes much more rapidly than that of vapour; and the result is, that the evaporated moisture has a constant tendency to ascend into the higher regions, which prevents the air at the surface from being saturated, and keeps up the evaporating process, while the warmer steam, mingling as it ascends with that which is already floating in equilibrium in the upper regions, occasions a precipitation,—and hence the various phenomena of clouds, mist, and rain. These phenomena, again, are modified by the circumstances previously described; and the various currents of warm and cold air, occasioned by many different causes, combined in numerous ways and in divers degrees, give rise to all the varieties of sunshine and cloud, moisture and drought, to which we apply the name of weather, and, by the due balance of which, the fertility of the different regions of the earth is secured.

Such is the general nature of the wonderful mechanism of the atmosphere, so wisely and so bountifully adapted to the

* Whewell's Bridgewater Treatise, p. 101.

organized existences produced by the soil. But there are other particulars, also, which must not be forgotten. Among these, the provision by which the rain is made to fall softly on the earth, and to be diffused in due proportions over its surface, is peculiarly worthy of notice. When we think of the vast quantities of water continually floating over our heads, and at the same time reflect on the irregular and apparently capricious motions of the atmosphere, there seems, at first sight, to be much that is calculated to fill us with alarm. Could we suppose an intelligent being to drop on our globe, and to be made acquainted with just so much of the powers which regulate the antagonist forces of steam and air in our atmosphere, as philosophy has discovered, and no more, while he remained ignorant of the manner in which these powers practically operate,—a kind of knowledge which we learn from experience,—what would be his conclusion? Let him be told that there is an amazing accumulation of moisture floating above the surface of the earth, and having a continual tendency, within certain bounds, to increase; but there are currents of air, sometimes breathing softly, sometimes driving furiously, sometimes expanding this moisture by its heat, sometimes suddenly precipitating it by its cold, sometimes dispersing it far and wide, sometimes strongly compressing it by pouring from opposite quarters. He would immediately say, if all this is not regulated by some other principle than appears—by some over-ruling Intelligence—there must necessarily be the most destructive inequalities in its distribution over the surface of the earth. It will fall sheer down in some places in one unbroken sheet, so as to overwhelm whole continents with a sudden and fatal deluge, while in other situations, an entire destitution of moisture will prove equally fatal to organic life. There is here no equilibrium,—no compensating nor equalizing principle, so far as can be observed. The elements in action, and the forces employed, are so opposite and so powerful, that nothing but confusion and ruin can be the result.

Such is the legitimate conclusion which a rational being

might form, without the aid of experience or the knowledge of a superintending Providence. But how different is the reality! The various phenomena of the weather, though irregular, and apparently capricious, when viewed from day to day, are yet preserved within salutary bounds, and wonderfully exhibit, in a series of weeks or months, a certain specific average, in a given locality, which is favourable for producing and nourishing the fruits of the earth. The cold or the heat, the sunshine or the gloom, may be longer protracted at one period than at another, but they are seldom carried to such an extreme as to prove injurious. The rain may sometimes fall in torrents, and occasional inundations may be the consequence; but such occurrences are rare exceptions from a beneficent rule. The moisture is generally distilled from the clouds in gentle and fertilizing drops, at such seasons, and in such quantities, as are best calculated for cherishing the peculiar vegetation of the regions where it falls. All these circumstances are obviously adjusted to the qualities of the soil, and of the vegetable principle, so as to give scope to the powers of life inherent in nature, and to spread abundance and enjoyment over the earth.

Here, then, we have a new proof of designing wisdom and diffusive goodness,—the more admirable, as it is entirely in harmony with the character of the rest of the Creator's sublunary works. We do not find a system free from imperfection, and unmingled with evil; but we see tremendous and destructive forces controlled and regulated with consummate skill, so as to harmonize with the other powers and conditions of the physical world, while these, again, equally harmonize with the circumstances of the moral world,—thus forming one amazing but mysterious whole. And when we turn from this aspect of Nature, to that of Revelation, and compare them together, we here, above all, are presented with arguments, analogies, and accommodations, which at once astonish and delight, confound and satisfy, the inquiring mind.

FIRST WEEK—SATURDAY.

SPRINGS.

WATER is not only essential to the growth of plants, but to the subsistence of animals. There is, however, this difference in the wants of these two orders of organized beings, that, whereas plants require only occasional supplies of this fluid, at considerable intervals, and are most luxuriant when, at particular seasons of the year, rainy weather is followed by uninterrupted sunshine, for several days or even weeks in succession, few living creatures can subsist without the daily use of water. Were the earth, therefore, only to receive moisture directly from the clouds in the form of rain, and under present conditions, vegetation indeed would subsist and flourish, but the animal world would soon become extinct. The provision by which this essential want is supplied, is that of fountains and springs of running water.

There is something very peculiar in the circumstances connected with this provision, which cannot fail to interest the contemplative mind. Mountains have already been stated as the general reservoirs from which springs derive their supplies; and, considered in this light, the peculiar form of the earth's surface, in which mountain ranges and elevated ground alternate with long extended valleys and champaign country, cannot but be considered as a beautiful provision of Divine intelligence. But there is something peculiar in the structure of the substances of which hills are usually composed, which is also obviously calculated to favour the existence of springs. They consist, generally, of stratified rocks, and, in many of the lower elevations, of gravel, through which the moisture passes readily, alternating with beds of clay or marl, where it is arrested in its downward progress, and forced by its natural tendency to seek for a vent in the open air; or, where the rocks are primitive, and are, therefore, generally, less permeable by water, there are fissures and hollows through

which the fluid sinks, and in which it is deposited, gradually accumulating till it finds egress in a running stream. In stratified districts this egress is frequently facilitated by what miners and geologists call *faults*, that is, breaks in the continuity of the rocks.*

The benevolent intention of this arrangement, is too evident to escape observation. Were there not beds of clay in the one case to intercept the water as it sinks, and fissures and openings in the other, in which it is received and accumulated, the earth would, by reason of an irregular supply of this necessary element, be rendered unfit for the subsistence of living creatures, and all the wonderful apparatus of vegetation which Providence has provided for their use, would have beon spread over its surface in vain. There would have been neither fountain nor river, and the whole earth would have been reduced to the state of the inhospitable Steppes of Russia, where, on account of the absence of mountains and springs, there exists a vast extent of soil, often naturally fertile, but, except where the waters of distant regions sluggishly meander, or are collected in lakes and pools, unfit for the support of animal life.

There is yet another circumstance, at once curious and important, connected with the geological structure of the earth, as regards a supply of water, which I must not omit to mention, more especially as it illustrates, in a striking manner, a very remarkable feature in the arrangements of the Creator with reference to His rational creatures, to which I have al ready had occasion, in the preceding volume, more than once to advert, and of which the provisions connected with the agricultural operations of the present season, will again and again forcibly remind us,—I allude to the fact, that however

* It is stated by Mr. Hopkins, that all the great springs in the limestone districts of Derbyshire, are found in conjunction with great faults.—'I do not recollect,' says he, 'a single exception to this rule, for, I believe, in every instance where I observed a powerful spring, I had independent existence of a great fault.'—*Philosophical Magazine, August* 1834, p. 131, *quoted by Dr. Buckland.*

bountiful may be the contrivances for the subsistence of organized existences which are naturally in actual operation, there are everywhere, latent and in reserve, many more, the discovery and application of which have been left to the ingenuity of civilized man; thus calling forth and rewarding his intellectual powers and active exertions, and laying the foundation for unlimited improvement in the arts and sciences. The circumstance which at present gives rise to this observation, is the discovery of what are called Artesian Wells, by which is meant, "perpetually flowing artificial fountains, obtained by boring a small hole through strata that are destitute of water, into lower sheets of this important fluid, which ascends by hydrostatic pressure, through pipes let down to conduct it to the surface."

There are numerous instances of this application of human skill to the supply of what was a desideratum in particular localities, both in this country and on the continent. The word is derived from the district of Artois (the ancient Artesium), where the want of natural springs has, for a long period, induced the inhabitants to apply to this most effectual resource. The quantity of water thus obtained in Artois, is often sufficient to turn the wheels of corn-mills. The following is an abstract of the account given by Dr. Buckland of this remarkable method of extracting a supply of water from the bowels of the earth:—'It appears that there are extensive districts in various parts of Europe, where, under certain conditions of geological structure, and at certain levels, artificial fountains will rise to the surface of strata which throw out no natural springs, and will afford abundant supplies of water for agricultural and domestic purposes, and sometimes even for moving machinery. In the Tertiary Basin of Perpignan, and the Chalk of Tours, there are almost subterranean rivers having enormous upward pressure. The water of an Artesian well in Roussillon, rises from thirty to fifty feet above the surface. At Perpignan and Tours, M. Arago states, that the water rushes up with so much force, that a cannon-ball, placed in the pipe of an Artesian well, is violent-

ly ejected by the ascending stream. In some places application has been made to economical purposes of the higher temperature of the water rising from great depths. In Wurtemberg, Van Bruckmann has applied the warm water of Artesian wells to heat a paper manufactory at Heilbraner, and to prevent the freezing of common water around his mill-wheels. The same practice is also adopted in Alsace, and at Cron stadt, near Stutgard. It has even been proposed to apply the heat of ascending springs to the warming of green-houses. By means of similar wells, it is probable, that water may be raised to the surface of many parts of the sandy deserts of Africa and Asia; and it has been in contemplation to construct a series of these wells along the main road which crosses the Isthmus of Suez.'*

Various other particulars might be mentioned; but I must dismiss the curious subject with this single additional observation, that by the judicious use of these hidden stores, thus providentially laid up, it may yet be in reserve for the ingenuity of man, materially to extend the boundaries of the habitable parts of the earth; bringing water, not miraculously, indeed, as Moses did, but by use of the rational powers with which he is endowed, out of the cleft rock, to cheer the barren wilderness, and to cause 'the desert to blossom like the rose.'

The geological arrangements which we have mentioned, correspond with, and are obviously intended to carry into effect, the beneficent contrivances belonging to the atmosphere. Fresh water evaporated from the salt sea, is held in solution in the air, and borne by currents over the face of the earth, which it moistens and renders fertile, as it passes along, being condensed into clouds, and precipitated in rain. What is redundant, after performing this useful office, flows off by means of springs, uniting into brooks, and then into rivers, which preserving life and diffusing fertility wherever they glide, complete the wonderful circulation of the fluid, by returning to the parent ocean; and thus, while they preserve

* Buckland's Bridgewater Treatise, vol. i. pp. 565–568

the balance of the sea and land, afford an additional instance of the wonderful analogies which pervade Nature.

Metastasio, in a passage of his dramatic works, has, with great beauty and poetic feeling, employed this tendency of water to find its way back to its original source, in shadowing forth the love that an affectionate heart bears to its native home—which has been thus elegantly translated by Dr. Beattie. I quote from memory:—

'Rivers from the ocean borne,
Lave the valley and the hill,
Prisoned in the fountain, mourn—
Murmur in the winding-rill.

Still wherever doomed to stray,
Still they warble and complain;
Still pursue their devious way,
Till they reach their native main.

After many a year of woe,
Many a long, long wandering past
Where at first they learned to flow,
There they hope to rest at last.'*

As the hills are the destined origin of springs and rivers, a remarkable provision is made for the supply of such natural reservoirs, by a far more abundant fall of rain in these elevated situations than on the lower grounds. The amount of this difference is much greater than is generally supposed, as

* The original is from the drama of Artaxerxes. It is still more soft and tender, and expressed in fewer and simpler words:—

'L'onda del mar divisa
Bagna le valle, e'l monte
Va passeggiera
In flume,
Va prigioniera
In fonte,
Mormora sempre, e geme
Fin che non torna al mar.
Al mar, dov'ella nacque,
Dove acquisito gli umori,
Dove da' lunghi errori,
Spera di riposar.'

has been proved by various experiments, and may be illustrated by the following, which is stated in the Supplement to the Encyclopædia Britannica, under the article Meteorology. In the neighbourhood of Kinfauns Castle, a rain-gage is placed on the summit of a hill six hundred feet above the level of the sea, and another in the garden at the base of the hill, about twenty feet above the same level. The mean annual result of the quantities which fell in each of the situations, on an average of five years, was, for the hill gage, 41.49—and, for the garden gage, 25.66, a difference which would lead to the conclusion, that the quantity of rain which falls on mountain ranges is nearly double that which waters the valleys. There can, at all events, be no doubt that the difference is great, arising chiefly from the well-known property of hills, by which they attract the clouds, and, extracting the electric fluid, dissolve them in showers.

Supposing, therefore, what has been alleged, that the quantity of evaporation which takes place from the surface of the earth, is not greatly inferior in quantity to the rain that falls upon the low grounds, and that, therefore, there would not, from this source, after the necessary supply of vegetation, be much surplus to return to the sea, yet the additional falls of rain on the hills seem amply sufficient to account for the innumerable rills and streams which intersect the land in all directions. Mr. Dalton has calculated, that the quantity of water annually discharged into the sea by all the rivers in England and Wales, does not amount to more than thirteen inches over the whole surface; and it is stated by M. Arago, that one-third only of the water which falls in rain, within the basin of the Seine, flows by that river into the sea. The remaining two-thirds either return into the atmosphere by evaporation, or go to the support of organized existences, or find their way into the sea by subterranean passages.

I cannot better conclude this paper, than in the words of the eminent Professor whom I have partly followed in the facts on which its reasoning is founded.—'In the whole machinery of springs and rivers, and in the apparatus that is

kept in action for their duration, through the instrumentality of a system of curiously constructed hills and valleys, receiving their supply *occasionally* from the rains of heaven, and treasuring it up in their everlasting storehouses, to be dispersed *perpetually*, by thousands of never-failing fountains, we see a provision not less striking than it is important. So, also, in the adjustment of the relative quantities of sea and land, in such due proportions as to supply the earth by constant evaporation, without diminishing the waters of the ocean; and in the appointment of the atmosphere to be the vehicle of this wonderful and unceasing circulation, and thus separating these waters from their native salt (which, though of the highest utility to preserve the purity of the sea, renders them unfit for the support of terrestrial animals and vegetables), and transmitting them in genial showers to scatter fertility over the earth, and maintain the never-failing reservoirs of those springs and rivers by which they are again returned to mix with their parent ocean; in all these circumstances we find such evidence of nicely balanced adaptation of means to ends, of wise foresight, and benevolent intention, and infinite power, that he must be blind indeed, who refuses to recognize in them proofs of the most exalted attributes of the Creator.'*

SECOND WEEK—SUNDAY.

ADVANTAGES OF VICISSITUDE.

When the earliest snow-drop pierces the dark earth, like morning springing out of night, and gives promise of the coming genial season, the impatient spirit hails the tender harbinger, and already in anticipation revels in vernal delights. But many a pinching frost, and many a splashy thaw,

* Buckland's Inaugural Lecture, p. 13. See also the same author's Bridgewater Treatise, chap. xxii.

and many a shower of sleet, must be endured before winter will 'sound his trumpet in the blast, and call his storms away.' And many a fair and promising bud must be checked in its efforts to struggle into life, beneath the incongruous alternations of cold and sunshine. Yet the sunbeam which bids the sap ascend, and summons the bud into existence, is not more salutary, or more necessary for the security of the future fruit, than is the storm which repels its too hasty growth, and seems to threaten its destruction. Variety seems the very essence of health and vigour in the natural world, as it is in the moral. Who could endure the tedious sameness of skies ever blue, a sun ever shining, earth ever green, and streams ever gliding in tranquil brightness? The very deliciousness of Nature's beauties would, after a time, render them nauseous. The weary eye would long for the interposing canopy of clouds, and the friendly return of evening. A patch of wilderness and moorland would be hailed with joy; and flood and rock enough to form a cataract, might serve to chase the *tedium vitæ*, which would otherwise steal upon us. The mind is not allowed to stagnate in one train of contemplations, by the uniformity of surrounding objects, any more than its dwelling-place the body, is allowed to become listless and enervated by the sameness of its sensations. We learn to appreciate our comforts by means of occasional privations, and find reason to adore the majesty and grace of the beneficent Being, who not only smiles in the sun-beam, but frowns in the storm.

'Yesterday the sullen year,
Saw the snowy whirlwind fly,
Mute was the music of the air,
The herd stood drooping by

* * * *

The hues of bliss more brightly glow,
Chastised by sabler tints of woe;
And, blended, form with artful strife,
The strength and harmony of life.

See the wretch that long has toss'd,
On the thorny bed of pain;

At length repair his vigour lost,
And breathe and walk again.

The meanest flow'ret of the vale,
The simplest note that swells the gale,
The common sun, the air, the skies,
To him are opening paradise.'*

So says the poet, with equal beauty and correctness. Every enjoyment is enhanced by privation; and our necessity of change is a strong evidence of our infirmity, and of the transition state in which we are placed. The Hindoo devotee, who has clenched his fingers till the nails have protruded themselves from the back of his hands, or drawn up a limb, and retained it in one position till its contracted sinews no longer suffer him to wield it, gives evidence that absolute rest was not made for man. However sweet repose may be to a weary pilgrim, beyond a certain point repose itself will become a weariness. The hungry cannot always feed, or the thirsty drink for ever. 'Man and for ever!' once exclaimed a statesman, in a fine burst of irony,—'Man and for ever!'—Most truly an idle combination,—a contradiction in terms as relates to his sublunary state. Yet man exhibits his unconscious longing after immortality, by his propensity to use terms inapplicable to his present condition. If he loves, he will love *for ever:* If he is grateful, he will *never* forget: If he forms a friendship, it is to be *eternal.* We talk of *for ever*, yet there is nothing perpetual but change; and our ease and enjoyment in this fleeting scene depend on that perpetuity of change.

There is but One who is always of one mind, whose purposes stand fast, and all whose actings are uniform. The wisest of men turned his weary eye from the contemplation of that which he found to be vanity and vexation of spirit, and fixed his confidence on this One. 'I know,' says he, 'that whatsoever God doeth, it shall be for ever; nothing can be put to it, nor any thing be taken from it, and God doeth it, that men should fear before him.' It is this great Artificer,

* Gray's Ode to Vicissitude.

then, who operates upon the changeful human being; and that which forms our variety, and our vicissitude, is but the recurrence of the same effects from the same causes, altered only by new combinations; it is the repetition of the same unchanging laws, which are without variableness in the hand of Him who formed them. Fitly, therefore, is our lot placed in His hand; and while his beneficent contrivance has rendered vicissitude delightful, a much more weighty object is attained under its influence than merely enhancing felicity, or adding pungency to enjoyment.

He who knoweth what is in man, sees the necessity of 'emptying us from vessel to vessel,' as the prophet strikingly remarks, using the figure of one preparing wine, whose purpose is, by each outpouring of the liquor, to leave a portion of the lees behind. The fairest character in our fallen condition, even amongst those who are renewed in the spirit of their minds, retains its alloy of lees, and requires to be dealt with that it may be refined, and have the pure separated from the vile.

Scripture is rich in figures, which represent this fact in all the forms that may arouse and fix attention. At one time the gracious Lord, whose purpose it is to render his people meet for a dwelling in his own presence, describes himself as a refiner and purifier of silver; adding more heat to the furnace till the object is obtained, while he 'sits' to observe the process, and at last sees his own image reflected in the precious metal. At another, he is represented as a vine-dresser, who when he sees a branch bringing forth fruit, immediately 'purgeth it, that it may bring forth more fruit.' In one place, His gospel is compared to leaven, which introduces its transforming influence into a measure of meal, and continues till it has operated on the whole mass, and subjected it to a salutary change. In another, Ephraim, when rebuked for his ingratitude and forgetfulness of God, is compared to 'a cake not turned,'—he has had no changes, and therefore has forgot his God; and the consequence is, that strangers have 'devoured

his strength, and he knoweth it not; yea, grey hairs are here and there upon him, yet he knoweth it not.'

My Christian reader will readily confess that his experience has been as that of Ephraim. Has he remained long at ease? Has the world prospered with him? Has his family arisen around him to honour and to cheer him? It was not *then* that he walked most closely with God; it was not then that the word was as a light to his feet, and a lamp without which he dared not move; it was not then that prayer was his hourly breath. It was then, on the contrary, that false friends or divers worldly pursuits had power to draw him aside, to devour the strength of his faith, the energy of his hope, and the stedfastness of his love; yet he did not perceive it. Nay, he was growing old, and approaching to his account, the silver of years was mingling with his once graceful locks, yet he knew it not. He has been at ease, and suffered loss, and a change in his lot has become necessary to renew the impression of his dependance, his feebleness, his tendency to fall away. That cloak which hung loosely around the traveller, or was ready to drop off unobserved while the sun shone upon him, is resorted to with eagerness when the storm begins to beat; and the more rudely the tempest blows, the more closely does he enwrap himself in it. Thus it is with the Divine protection and support. Let the backslider be touched with the rod of adversity, and suddenly his repentings are kindled together. Turn but one of his earthly delights into a grief, and he returns quickly to seek, if haply he may revive in his breast, the great privilege of communion with his God, which erewhile had been slighted and treated as a common thing. Open to him the prospect of the grand, the final change to which as a mortal he is exposed, and suddenly his supineness is at a close, and all is hurry to re-examine his evidence, and to recover what, in his days of uniformity and ease, he had lost.

Prosperity may leave us at liberty to rejoice while we mark the hand of Providence, but adversity adds to the lesson that of teaching us to bow under it. The hour of gladness may

be the hour of thankfulness, but the hour of calamity is that of faith in the promises. It is to the covenant-keeping God that the afflicted spirit turns, and at his footstool is it taught to plead all that he has done in time past, and all that he has engaged to do in time to come. It is the hour of painful vicissitude that brings our sins to mind, and with them the realizing conviction that 'God requireth that which is past.' The brethren of Joseph seem not to have laid their heartless barbarity to the amiable youth to heart, till the great man in the court of King Pharaoh spake roughly to them. Then, when they felt themselves to be despised strangers and foreigners, pleading for bread in an unfamiliar tongue, they remembered their heart-burnings against the guileless boy, and the dry pit in the field, and the perfidious barter by which they at once gratified their malice and their avarice, and the grief of the venerable parent, and their hypocritical sympathy. All this in the hour of their calamity flashed on their mind, and without any other association to lead to the subject, they turned to each other, and said, 'We are verily guilty concerning our brother, in that we saw the anguish of his soul when he besought us, and we would not hear; therefore is this distress come upon us.' Such is the salutary influence of vicissitude; and so wonderfully does our Heavenly Father over-rule even disappointment and unwelcome change, for the moral improvement of his rational offspring.

M. G. L. D.

SECOND WEEK—MONDAY.

RIVERS.

The cursory remarks which we have already made on springs and rivers, are far from exhausting the subject, and there are various other circumstances connected with the beneficent arrangement, which this paper is intended to describe.

Rivers, as has already been stated, owe their origin to mountains, and other elevations of the earth's surface. Were the land a dead level, we could have no running water, for a stream only moves because of the elevation of its source above its channel. At first, perhaps, a tiny streamlet, caused by the overflowing of the waters of a spring from its rocky basin, the youthful river is gradually enlarged by mountain brooks, almost equal to itself, pouring into it on either side, and by casual yet large supplies, from rain, mist, and melted snow. Near its source it is easily fordable, or is crossed by some rough tree or plank; but widening and deepening as it goes, it is at length only to be traversed by the ferry-boat, or by a series of lofty arches, connected into one magnificent bridge. It waters and fertilizes innumerable fields; mighty forests owe to it their stateliness and beauty; it furnishes drink to unnumbered flocks and herds, and to the inhabitants of populous cities; and after discharging a thousand salutary offices, whether in supplying man with its wholesome waters, or in draining an entire region of its impurities, it at last mingles its flood with the ocean.

Lakes and inland seas are commonly either formed and fed by a number of rivers, or they are but the expansion of a single stream. On a river flowing into a valley, surrounded on all sides by elevated ground, it is evident that its waters, unless they escape by some subterraneous channel, must collect, spread over a considerable surface, and rise to the level of the lowest outlet, through which they will then pass on in their way to the sea. The higher the waters have to rise before finding egress, the broader and deeper usually will be the lake that is thereby formed. Many feeders from the surrounding eminences also fall into the expanded sheet of water. Thus the lakes of Constance and Geneva may be viewed as respectively formed by the Rhine and the Rhone, and enlarged by smaller auxiliary streams. The Dead Sea, whose nauseous waters cover the site of the doomed cities of the plain, is an expansion of the Jordan. But in this instance the ground was miraculously burnt up, so that the river which formerly

beautified the whole plain in its uninterrupted progress, now empties itself into a vast cavity, and forms a lake from which there is no egress to the sea, and which, indeed, has been ascertained to be nearly a hundred feet below the level both of the Red Sea and the Mediterranean.

It has been observed, that more rivers run east or west than either north or south; and this has been accounted for by geologists from the fact, which many concurrent phenomena seem to establish, that the valleys of mountain ranges have been scooped out by a mighty current of waters, whose direction has been, speaking generally, from west to east. Thus the Po and the Danube run eastward, and the Tagus westward, according to the direction of the plains and basins which separate the mountains that produce them. Even though an extensive mountain chain runs north and south, the rivers that rise in it may yet flow east or west; for the lower ranges of hills may, and generally do, run in that direction. The Amazon, the Orinoco, and the La Plata, in South America; the St. Lawrence, the Ohio, and the Missouri, in North America, and, indeed, most of the rivers of these vast continents flow towards the east or the west, though the Andes in the former, and the Alleghany and the Rocky Mountains in the latter, run northward and southward.

The exact number of rivers in the globe can scarcely be ascertained; but it has been computed that in the united continents of Europe, Asia, and Africa, about 450, and in North and South America about 200, principal streams, discharge themselves directly into the ocean. Of brooks and tributaries there is a countless multitude. Every province of the earth is intersected with them, as with innumerable meandering streams, all subservient to the circulation of that indispensable fluid, water. When we consider the vast size of many rivers, in connexion with the number of the whole, the quantity of water they must convey to the sea appears truly incalculable. It has been computed that the Po, which, near its mouth, is 1000 feet broad, and ten feet deep, and has a velocity of four miles an hour, discharges five billions of cubit

feet of water per day, or nearly two trillions, that is, about fourteen cubic miles annually. How enormous, then, must be the annual tribute of the Amazon, before which the Po dwindles into a tiny streamlet. This majestic river, or inland flood, is 3600 miles in length, and at its mouth forms an estuary 150 miles broad. Its depth in many places is said to exceed 100 fathoms. We may form some idea of the quantity of water annually discharged into the ocean by rivers, when we learn that it amounts, on the most moderate calculation, to 1400 times the quantity discharged by the Po. Were it not for this immense and never-ending drain, the whole earth would soon be under water; for the evaporation from land and sea is so great, that though only a third of it fall upon the land, in the shape of rain or snow, and about two-fifths of that third be dissipated again through the atmosphere, or absorbed in the processes of vegetation, there will yet remain a superfluous quantity sufficient to deluge entire continents.

Rivers may, at first sight, appear to obstruct inland communication; but, in reality, they greatly facilitate it. Through their means, ships can visit the interior of mighty regions, and merchandize can be conveyed from one place to another in boats and rafts. When they are not suitable for navigation, on account of their shallowness, or of some peculiar obstructions, they can yet supply with water navigable canals. They also furnish man with a power almost unlimited, in turning the wheels that set in motion his vast piles of machinery. So useful, in many ways, are rivers, that almost all towns are situated upon their banks. It would appear, indeed, that no town can flourish unless it lie upon the sea-shore, or upon the banks of some considerable stream; while to rivers many towns owe their pre-eminent greatness. London, that most wealthy and wonderful of cities, is indebted for most of its mercantile grandeur to the Thames. Though seventy miles from the sea, it is visited by thousands of ships from every region of the globe, and into its ample docks and warehouses are incessantly poured the treasures of the east and the west. Its noble river is the king of floods, if commerce can give the pre-eminence.

Rivers, with mountains, form the best boundaries and bulwarks of kingdoms. In the time of war, they retard the progress of an invading foe, while they furnish the inhabitants of an invaded country with a most effective means of defence. The fishes, with which rivers abound, afford us a wholesome and delicate species of food. The motion of their currents also adds to the salubrity of the climate, by agitating and purifying the air.

The surpassing beauty of rivers gives a last charm to their utility. They are not only beautiful in themselves, but they are the causes of beauty wherever they flow. What object in Nature is more grandly interesting than a river among its native steeps, flinging itself sheer down some precipitous cliff? Or what more graceful and pleasing than the same river, escaped at last from the mountainous tracts, and augmented with numberless tributary streams, winding in dallying meanders along the fertile valley, clothing in living green the meadows and stately woods upon its borders, now dashing through lofty arches of stone, and now washing the walls of ancient cities and towers, bearing in its lucid bosom gay pinnaces and barges, and strange ships from foreign lands, while it approaches, with still increasing majesty and beauty, the ocean, its final and glorious destination? Thus the scenery of the river shore is of the most picturesque and delightful description. The sweet spots of the earth are watered and beautified by brooks and rivers; and no where is the grandeur of nature more visible and pleasing, than in the cataracts and rapids, and resounding currents of those mighty floods that issue forth from the mountains, to spread beauty and abundance over the rejoicing plain.

Rivers, therefore, destructive as they sometimes are in their rapid inundations, form an indispensable part of those grand arrangements by which the Creator renders the earth the fit and lovely abode of animal and vegetable life. So useful are they, that a country is rich in proportion to the number and extent of them within its limits. Thus, in every portion or general feature of nature, we find inexhaustible proofs of

matchless wisdom, of overflowing goodness. Streams and rivers murmur forth the glory of God; and, ever since the creation, they have been the ministers of his bounty. When the great Architect of Heaven and Earth himself formed an abode suited to the innocence and dignity of the noblest of his creatures, and gave it unto our first parent, as the scene of his happiness and sinless labours, he sent forth a river to water it, and make it fruitful, and to complete the beauty of its scenery. J. D.

SECOND WEEK—TUESDAY.

VEGETABLE SOIL.

In treating of the various operations of nature in this, as well as the other seasons of the year, I shall follow the plan adopted in the volume on Winter, by examining the diversified conditions of organized life in their natural order; beginning with the productions of the soil, and rising through the various genera of animals, till we arrive at man, the last called into existence, and the chief of the Creator's sublunary works. In the present paper, our attention shall be directed to the character and qualities of the soil itself.

In the previous volume it was mentioned, that in its primitive state, the crust of our earth seems to have been barren, waste, and void, consisting entirely of rocks and water, without soil, without vegetation, and without animal life; and that the first scanty soil was gradually formed by the breaking down and abrading of the rocks, which prepared nature for the sustenance of organized beings. Such is the geological theory; but whether it be admitted or not, there is no doubt that our present productive soil consists chiefly of minute particles of stone, mingled with calcareous substances, which are the spoils of marine animals, and with fat earth, being the remains of all kinds of organized bodies in a state of decomposition.

With this kind of soil, we find the surface of the earth generally covered to a greater or less depth. There are, indeed, exceptions to this, which give rise to rocky and barren wastes; but these exceptions serve to confirm the general rule, and are not so numerous as to throw the slightest doubt on the intention of the arrangement, so wise and so beneficent, by which most extensive provision has been made for a vegetation suitable to the support of living creatures over the surface of the earth.

It might have been otherwise. There seems to be nothing in the ordinary laws of nature which rendered such an arrangement necessary, or even probable. It is true, that a disintegration of rocks is occasioned by the action of the atmosphere; and that water, whether in the form of rain, of mountain torrents, or of constantly flowing rivers, is continually and actively employed in spreading the soil thus formed, over the low grounds, or carrying it into lakes or seas, on which it makes encroachments, by the formation of new deposits. But such causes, however powerful they may be, could only be partial in their operation. They tend to fill up valleys, and extend the boundaries of the dry land; but the extent of their operation must, even in a long series of ages, be comparatively very limited. Such agents give rise merely to what has been called alluvial soil, such as is found along the low banks, and at the mouth of rivers; and, if these were the only places where soil was deposited, it is easy to conceive what a naked and sterile waste the general surface of the earth would be. By far the greatest proportion of the soil is to be found in situations, and under circumstances, where the action of water, in any of the ways we have enumerated, instead of accumulating it, must have a tendency to wash it away. Such is the earth which covers all the elevated grounds, from the mountain ranges down to the gentle declivities which form by far the greater part of the cultivated lands. This is called *diluvium* by geologists, because, as stated in the preceding volume, it is justly believed to have been deposited by the turbid and agitated waters which passed over the surface of

the globe, either immediately before the era of the Mosaic creation, or during the subsequent deluge in the time of Noah, or rather at both these periods.

But whatever were the agents employed, the effect is altogether providential; and the more we consider the general aspect of the earth, in other particulars, the more reason will we have to believe that the fertile covering with which it is enveloped, is the arrangement of an Intelligent and Contriving Mind. Malte Brun, in his System of Geography, says, that "the structure of the globe presents, in all its parts, the features of a grand ruin;" and, for the truth of this, he appeals to the confusion and overthrow of most of its strata; the irregular succession of those which seem to remain in their original situations; the wonderful variety which the direction of the veins, and the forms of the caverns display; the immense heaps of confused and broken substances, and the transportation of enormous blocks to a great distance from the mountains of which they appear to have formed a part. All this is undeniable and striking, and obviously indicates some mighty catastrophe, or succession of catastrophes, by which the ancient strata of the earth have been broken up, overturned, and dislocated. But the more we become aware of the disorder in which the materials of the earth are placed, the more will we be struck with the proofs which meet us on every hand, of a regulating and over-ruling Power, which has controlled that seeming disorder, and rendered it subservient to His own beneficent purposes. I have already had occasion to advert to this view, in other instances; but let us at present apply it to the subject before us. Had the disruption and ruin alluded to by Malte Brun, and familiar to all geologists, taken place by the mere agency of mechanical causes—by some accidental explosion, for example, of a central fire, or by some oversetting of the equilibrium of the earth, or by the casual collision of a comet, without the intervention of Divine Wisdom, can it be supposed that this vast ruin would have been every where so wonderfully overspread with a soil fitted for the nourishment of vegetable and animal

life? On the doctrine of chances, is this within the bounds of probability? It is not denied, indeed, that there are ranges of rocky mountains, and a considerable extent of barren deserts; but, even allowing that such interruption to the general fertility were really a defect in the system, which, as regards the former, has been shown to be far from the truth, does not the actual arrangement, after making every possible deduction, appear clearly to be such as to preclude all idea of its being fortuitous? No candid man, who adverts to the nature of the substances of which the crust of the earth is composed, can resist the conclusion, that the clothing of its surface with vegetable mould is as much a display of skill and intention, as the enclosing of the human body in an elastic and sensitive skin, or the covering of the winged tribes with the beautiful apparatus of light and downy feathers.

In adverting to the properties of the soil, there are several things very worthy of remark, with regard to which a slight and cursory observation may at present suffice. To insure its fertility, it is necessary, on the one hand, that it should be sufficiently open and pulverized, to imbibe the moisture which falls from the heavens; and, on the other, sufficiently tenacious to retain it in a certain proportion, while it rejects what is superfluous. That this requires some nicety of adjustment, every agriculturist is well aware, as well as that, taken on an average, this adjustment has actually been established. Had the soil been, in any great degree, either more retentive or more porous, it would not have been fit for the nourishment of plants. Again, there are certain qualities characterized as vegetative, which are essential to a productive soil. To particularize these would lead us too much into detail; and it seems sufficient to remark, that such qualities are very generally diffused. We do sometimes, indeed, as I have already stated, meet with unproductive tracts, and these wastes may occasionally be the effect of barren sand, or impervious clay: but, compared with the extent of the earth's surface, these are as nothing; and, when the various ingredients of mould suitable for vegetation, are considered, it cannot but be re-

garded as a proof of providential care, that they should exist in such profusion, and be so widely spread over every region of the globe.

I need scarcely add, that there is further required an adjustment between the soil and the weather, to insure the development of its fertile qualities, and that this adjustment also has been established. Whatever be the climate, from the extreme heat of the tropics, till, towards the poles, the cold becomes too intense for the comfortable existence of animal life, the earth is covered with the mould adapted for the nourishment of such vegetables as that climate is capable of bringing to maturity.

These considerations sufficiently indicate the superintendence of an Almighty Designer, and loudly call for the devout admiration and gratitude of that rational race on whom he has bestowed the high faculty of tracing his hand in his works, and the glorious privilege of giving utterance to the sentiments which his perfections inspire.

SECOND WEEK—WEDNESDAY.

VEGETATION.

Of all the wonders with which we are surrounded, in this mysterious world, there is none more worthy of admiration than the principle of life in organized existences. Its essence is far beyond the human ken, but some of its properties we perceive and can investigate.

The chief intention of the Creator in all the arrangements on the surface of our globe, is, doubtless, the support and enjoyment of sentient beings; and, above all, the education of intelligent creatures for a higher mode of existence. But it would appear that the crude materials of which the unorganized crust of the earth is composed, were not found, in the great plan of the Creator, to be suitable for the first of these purposes, the sustenance of animal life; and therefore an in

termediate mode of existence was to be employed, by which the proper nourishment of living creatures was, by a most curious and skilful process, to be extracted from the soil, and to be scattered profusely over the face of the earth, in various forms, containing all the qualities of beauty and utility. Such is the vegetable world; a system which, while it admirably fulfils its primary destination, is at the same time adapted, with consummate wisdom, to perform other functions of great importance in the economy of the animated creation.

The first property necessary for the continued existence of vegetation, is the power of absorbing from the surrounding elements the materials which constitute its nourishment. For this purpose, each individual plant, with few exceptions, is connected with the soil by a root, and shoots up into the air by a stalk, and expands itself generally by means of branches and leaves, thus drawing its nutriment both from the soil and the atmosphere, and opening its bosom to the genial influences of light and heat. Again, provision is made for the secretion and assimilation of the various substances received into the system of plants, for the circulation of the nutritive juices, for the deposition of the solid materials in their proper situations; and, in short, for the development and maintenance of the whole organization. That organization itself is full of wonders. The elementary texture of a vegetable is formed of vesicles, the coats of which consist of transparent membranes of extreme tenuity, and of such minuteness, that, according to Kieser, the diameter of each individual cell varies, on a moderate estimate, from the 55th to the 330th part of an inch; so that, from 3000 to 100,000 cells would be contained in an extent of surface equal to a square inch. Kirby goes far beyond this statement, and assures us that these vesicles are occasionally so inconceivably minute, as not to exceed in diameter the thousandth part of an inch; in which case, no fewer than 300,000 of them might be contained in a square inch. These adhere closely together, and form by their union a species of cellular texture, which may be considered as the basis of every organ in the plant.

Fluids of different kinds are diffused over the plant, occupying both the cells and the intercellular spaces, which consist either of a watery sap, or of peculiar vegetable secretions. Among these vesicles are found, in most species of plants, numerous ducts, interspersed throughout every part of the system, containing air, and hence called *air-tubes*. There are also found in the interior of vegetables, certain organs named *glands*, which perform the important function above mentioned, of secretion, that is, the conversion of the juices, by a kind of alchymy, into the products necessary for the nourishment of the plants. Besides these internal parts, an external covering is provided, to protect the plant from the injurious effects of the atmosphere, and of the moisture it deposits. This is termed the cuticle, which is spread over the whole surface, investing the leaves and flowers, as well as the stem and branches; and this membrane is perforated in various parts, but especially in the leaves, with minute oval orifices or *stomata*, which have the power of opening and shutting, and are intended to exhale water, and perhaps sometimes also to absorb air.

The form and organization of the root is not less worthy of notice. Considered as the means of attaching the plant to the ground, the contrivance is most admirably suited to its function, this provision being proportioned to the degree of power required; so that, although in low shrubs and plants which are not destined to experience much external violence from storms, little precaution is exerted; yet in the case of lofty trees, and especially in such as are furnished with dense foliage and wide-spreading branches, which present a large surface and powerful lever to the wind, the most studied and skilful contrivances are adapted to enable them to take firm hold of the ground, and to resist the tremendous force with which, in tempestuous weather, they are assailed. Nor must another and still more essential function of the root be forgotten, I mean that of drawing the nutritive juices from the soil. This is effected by means of what are termed *spongioles*, situated at the extremity of the rooty fibres. These, acting

as sponges, from their resemblance to which they derive their name, imbibe the various vegetative qualities inherent in the earth, which, partly by means, as is generally believed, of capillary attraction, and partly by some mysterious vital power, are conveyed upward through the curiously organized vessels to form the food of the plant.

This rapid view of the general conformation of a plant, may suffice to show with what wonderful care the organization of the vegetable world is adapted to the condition of external nature, and how irresistibly the student of nature in this department is led to acknowledge the existence of Creative power and wisdom. It is reported of Galileo, the most profound philosopher of his age, that when interrogated by the Inquisition as to his belief in a Supreme Being, he pointed to a straw on the floor of his dungeon, and replied, that even if he had no other proof of an Intelligent Creator, the mechanism of that fragment of a plant would be sufficient;—and not without reason, for even in the form of a stalk of corn, there are indications of contrivance, the force of which no candid mind can resist.

Another essential property which belongs to vegetable life, is the power it possesses of propagating the species. One of the most marked conditions of organized existences is that of perpetual change. The plant rises and flourishes, and then, in a few years, frequently indeed in a few months, decays and dies. Had there not been some means employed, therefore, of preserving the species after the individuals had mingled with their parent earth, the world would have quickly been reduced to a barren and lifeless waste. But there is nothing more remarkable in the constitution both of the vegetable and animal worlds, than the careful provision which has been made for preventing this catastrophe, not only as respects organic life in general, but as respects each distinct kind of organized existence, which the plastic hand of the Creator has formed. All are endowed with an ample, and even redundant, capacity of giving rise to offspring of their own species. The manner in which this is almost uniformly effected in the

vegetable world, as I formerly stated, is by means of seeds, which they propagate in various forms, preserve by various contrivances, and scatter over the soil in various ways, and which are by their peculiar conformation and properties, as will afterwards be seen, most curiously and skilfully adapted to the functions they are destined to perform.

The properties we have mentioned are common to all, or at least to by far the greater part of terrestrial plants; and the remarkable uniformity which exists in their general structure, is a clear indication of One Contriving Mind. But the law of diversity is not less remarkable in their formation, than the law of coincidence and analogy. There are certain definite objects to be accomplished by each species, and in them all there is a striking conformity of type; and yet amidst this uniformity both of intention and of original model, there exists a variety at once interesting and surprising. This is the case not merely in the vegetable but animal world, in a degree which is exceedingly remarkable, even on the slightest inspection, and which grows upon us as it is contemplated. 'In every department of nature,' says Mr. Kirby, from whose work the facts contained in this paper are drawn, 'it cannot fail to strike us, that boundless variety is a characteristic and predominant feature of her productions. It is only when the object to be attained is dependant on certain definite conditions, excluding the possibility of modification, that these conditions are uniformly and strictly adhered to. But wherever that absolute necessity does not exist, and there is afforded scope for deviation, there we are certain to find introduced all those modifications which the occasion admits of. Not only is this tendency to variety exemplified in the general appearance and form of the body, but it also prevails in each individual organ, however minute and insignificant that organ may seem. Even when the purpose to be answered is identical, the means which are employed are infinitely diversified in different instances, as if a design had existed of displaying to the astonished eyes of mortals, the unbounded resources of Creative power. While the elements of structure are the

same, there is presented to us in succession every possible combination of organs, as if it had been the object to exhaust all the admissible permutations in the order of their union.'

SECOND WEEK—THURSDAY.

PRESERVATION AND DISTRIBUTION OF SEEDS.

I HAVE already stated, that the chief method by which the Author of Nature has provided for the reproduction of plants, is by means of seeds. This method may be considered as universal, for there is no perfect plant which is not produced by means of a seed; although other methods, also, are sometimes employed, such as propagation by means of runners or off-sets, or by the rooting of branches. Seeds, as I have noticed, resemble in some remarkable particulars, the eggs of fowls and insects; and, in the same analogy, the spawn of fish may also be included,—thus exhibiting one of those features, by which the various orders of organized beings appear to be so mysteriously related, and in which we trace so unequivocally the handiwork of a common Creator.

There are many tribes of vegetables, which from year to year, depend entirely for their reproduction on seeds. The plant having given birth to this embryo of its species, and deposited it in the soil, withers down to the root and expires. Now let us look at this curious production. It is composed of various parts, named cotyledons, corcle, membranes, and vessels. The cotyledons are composed of a cellular network, curiously organized, which forms the substance of the seed, and contains the albuminous matter, which nourishes the young plant in the earlier stages of its existence. The corcle is the embryo of the future plant, and lies between the cotyledons; it differs in its structure at different stages, consisting at first of a thin glary fluid, and afterwards becoming more concrete and regularly organized, till at last it displays the rudiments of the root and of the plumale, or future stalk. We have

named the seeds of plants, vegetable eggs; and every one must observe in this description, a remarkable similarity between the eggs of animals, and these productions of an inferior kingdom; and this remarkable resemblance to the animal embryo, is still further exhibited in the existence of an umbilical cord, which attaches to the seed till it be perfectly ripe, and through which it receives its nourishment from the parent plant.

These seeds, when it is intended that they shall lie dormant, in a temperate climate through the winter, to reproduce the species in spring, are furnished with every property necessary for the intended purpose. They remain in the bosom of the ground, sometimes protected by peculiar contrivances to preserve them from the severity of the season; but, whether this be the case or not, they are always endowed with qualities, or subject to conditions, which are sufficient for the preservation of the species, being, generally speaking, uninjured by the cold and wet, and unaffected by the alternations of comparative heat and cold, till the genial season of spring returns, when they can extend their roots, shoot forth their plumules, raise their foot-stalks, and unfold their tender leaves with impunity.

We have already observed, that this mode of propagating the species is universal: It belongs to all the various orders of plants, whether herb, shrub, or tree, and whether annual, biennial, or perennial. Some of these species preserve their seed in the pod, through the winter months, and others both produce and scatter their seed in the early part of the vegetating season, so as to give rise to the seedling, or the full grown plant, before the cold weather, which ends the year, has set in. These varieties, in the manner in which the seed is employed, occasion the necessity of varieties, also, in the mode of propagation, which are abundantly curious and admirable. Some seeds are enclosed in shells, others in purses; some are lodged in capsules, some in wooden sheaths; and others again, are placed deep in the heart of fruit, which serves at once for their protection and nutriment, and, in some instances per

haps, also for a rich and appropriate manure, as it decays on the surface of the earth.

In speaking of fruit as the means by which the seed is frequently shielded, I do not forget that this very fruit forms the food of various animals; and this gives rise to another proof of Creative contrivance; for while the food itself is digested, and affords nourishment to the animal, the seed in many instances is voided uninjured, and perhaps better prepared for vegetation; and it is thus that the Creator has provided for the dissemination of various plants, and even for their transportation to islands, and other localities, which they could not otherwise reach.

This leads me to state, that if some provision were not made for the dissemination of plants, they would seldom be far removed from the locality of the parent. Contrivances, therefore, for this purpose, were requisite, and they are many and singular. Numerous seeds, for example, are furnished with an elastic pod, which, on bursting, projects its contents to a considerable distance. Of this we have a well-known example in the common furze. Nearly all the seeds of compound flowers are provided with a species of wings, through which means they are conveyed, by the wind, to distant places. The thistle and dandelion are of this kind. Other seeds, as the bur, are scattered abroad, by laying hold, by means of hooks, on passing animals; and not only do birds and some quadrupeds perform, as we have stated, an important part in this useful office, by swallowing the seeds contained in berries and fruits, but some animals, both of the insect and larger orders, contribute to the same end by their storing instincts. Nor must we forget the effects of streams and rivers in the accomplishment of this useful intention. So various and so wise are the means by which the Creator accomplishes this beneficent purpose.

To all this I must add the power with which the Author of Nature has endowed various seeds, of retaining the vital principle for a lengthened period. Ray mentions, that, after the great fire in London in 1666, a plant (*Sysimbrium iris*),

the seeds of which must have lain dormant for several hundred years, covered, to an amazing extent, the walls of the buildings which had been burned.* The seeds which are sometimes discovered enclosed within the cerements of Egyptian mummies, and which have been found to germinate when lodged in the soil, is another remarkable example. Gerardin mentions other instances of the same kind; and, in particular, one which happened under his own eye, in the 'Jardin des Plantes,' all which shows in seeds a wonderful tenacity of life, doubtless implanted for a wise and obvious purpose. This, indeed, is only another instance of what we have already noticed, that, in the operations of the Author of Nature, there appears to be no intention more apparent, or more sedulously pursued, than that of the preservation and

* The following observations on this curious subject, are extracted from a notice in Professor Jameson's Philosophical Journal, for the quarter ending January, 1826. '*Spontaneous Plants.*—Few things are more extraordinary than the unusual appearance and development of certain plants, in certain circumstances. Thus, after the great fire in London, in 1666, the entire surface of the destroyed city was covered with such a vast profusion of a species of cruciferous plant, the *Sisymbrium iris* of Linnæus, that it was calculated that the whole of the rest of Europe did not contain so many plants of it. It is also known that, if a spring of salt water makes its appearance in a spot, even a great distance from the sea, the neighbourhood is soon covered with plants peculiar to a maritime locality, which plants, previous to this occurrence, were entire strangers to the country. Again, when a lake happens to dry up, the surface is immediately usurped by a vegetation, which is entirely peculiar, and quite different from that which flourished on its former banks. When certain marches of Zealand were drained, the *Carex cyperoides* was observed in abundance; and it is known, that this is not at all a Danish plant, but peculiar to the north of Germany. In a work upon the Useful Mosses, by M. de Brebisson, which has been announced for some time, this botanist states, that a pond in the neighbourhood of Falain having been rendered dry, during many weeks in the height of summer, the mud, on drying, was immediately and entirely covered, to the extent of many square yards, by a minute compact green turf, formed of an imperceptible moss (the *Phaseum axillare*), the stalks of which were so close to each other, that, upon a square inch of this new soil, might be counted more than 5000 individuals of this minute plant, which had never previously been observed in the country.'—P. 209, Article *Scientific Intelligence.*

propagation of the various species of organized existences which his Creative Power has formed. So true is this, that, throughout every department, an inquirer cannot fail to be deeply impressed, at once with the diversity, the admirable adaptation to circumstances, and the efficiency of the contrivances by which the object is effected.

SECOND WEEK—FRIDAY.

LONG VITALITY OF SEEDS.

After writing the preceding paper, I met with some curious observations, by Mr. Jesse, on the long vitality of seeds, which are so appropriate, that I adopt them as the subject of this day's consideration. They will be found to be in perfect harmony with the facts alluded to yesterday, and may perhaps tend to explain some of the curious circumstances mentioned in the note extracted from Professor Jameson's Journal.

'Few things appear to me more curious than the fact, that the seeds of various plants and flowers, which have lain dormant in the ground through a succession of ages, have either, by being exposed to the air, been enabled to vegetate, or have been brought into action by the application of some compost or manure agreeable to their nature.

'This was shown in trenching for a plantation at Bushy Park, which had probably been undisturbed by the spade or plough since, and perhaps long before, the reign of Charles I. The ground was turned up in winter, and in the following summer it was covered with a profusion of the tree-mignionette, pansies, and wild raspberry,—plants which are nowhere found in a wild state in the neighbourhood;—and, in a plantation recently made in Richmond Park, a great quantity of the fox-glove came up, after some deep trenching. I observed, a few years ago, the same occurrence in a plantation in Devonshire, the surface of which was covered with the dark-blue

columbine,—a flower produced in our gardens by cultivation, and I believe not known in this country in its wild state.* A field, also, which had little or no Dutch clover upon it, was covered with it, after it had been much trampled upon, and fed down by horses; and it is stated, from good authority, that, if a pine forest in America were to be cut down, and the ground cultivated, and afterwards allowed to return to a state of nature, it would produce plants quite different from those by which it had been previously occupied.

'So completely, indeed, is the ground impregnated with seeds, that, if earth is brought to the surface, from the lowest depth at which it is found, some vegetable matter will spring from it. I always considered this fact as one of the surprising instances of the power and bounty of Almighty God, who has thus literally filled the earth with his goodness, by storing up a deposit of useful seeds in its depths, where they must have lain for a succession of ages, only requiring the energies of man to bring them into action. In boring for water lately at a spot near Kingston-on-Thames, some earth was brought up from a depth of 360 feet. This earth was carefully covered over with a hand-glass, to prevent the possibility of other seeds being deposited upon it; yet, in a short time, plants vegetated from it. If quicklime be put upon land, which, from time immemorial, has produced nothing but heather, the heather will be killed, and white clover will spring up in its place.

'A curious fact was communicated to me, respecting some land which surrounds an old castle, formerly belonging to the Regent Moray, near Moffat. On removing the peat, which is about six or eight inches in thickness, a stratum of soil appears, which is supposed to have been a cultivated garden in the time of the Regent, and from which a variety of flowers and plants spring, some of them little known, even at this time, in Scotland.

'The care which is taken to supply the ground with those

* I have since learned that the Columbine is found wild in the western counties.

seeds, which, from probably being of a farinaceous nature would not preserve their vital powers through a succession of ages, as other seeds do, is very curious. Many of them are deposited by crows, and other birds and animals. The Rev. Mr. Robinson, in his "Natural History of Westmoreland and Cumberland," says that "birds are natural planters of all sorts of trees, disseminating the kernels upon the earth, where they grow up to their natural strength and perfection." He tells us, that early one morning he observed a great number of crows, very busy at their work upon a declining ground, of a mossy surface; and that he went out of his way on purpose to view their labour. He then found that they were planting a grove of oaks.* The manner of their planting was thus:—They first made little holes in the earth with their bills, going about and about till the hole was deep enough, and then they dropped in the acorn, and covered it with earth and moss. "The young plantation," Mr. Robinson adds, "is now growing up to a thick grove of oaks, fit for use, and of height sufficient for the crows to build their nests in. On telling the circumstance to the owner of the ground, who observed the acorns to spring up, he took care to secure their growth and rising. The season was the latter end of autumn, when all seeds are fully ripe."

'Mr. Edwards observes, that even the droughts of the autumn continue to increase and propagate seeds and plants; for, by causing deep chinks or chaps in the earth, the seeds of trees, and larger plants, that require depth, are lodged at proper depths for their growth, and, at the same time, secured from such animals as feed upon them.

'Mice also bury a great number of seeds for their winter stores, many of which vegetate:

Sæpe exiguus mus
Sub terris posuitque domos, atque horrea fecit,—

and some seeds are provided with a sort of down, by which

* I have observed in another place, that rooks probably bury seeds, for the purpose of feeding upon them in winter.—H. D.

they are carried, with the help of the wind, to great distances; and others fix themselves on the ground by means of a glutinous substance attached to them.

'It is a curious fact, in proof of what has been advanced, that more recent deposits of earth, such as peat, leaf-mould, &c., produce little or no vegetable substances, while, as has been shown, soil, from whatever depth it is brought, is impregnated with seeds, which grow freely on being exposed to the influence of light and air.'

May not some of the curious and interesting facts above quoted, from an acute observer of nature, corresponding as they do with similar instances, well known to the naturalist, be referred to the period of the universal deluge, and account, without difficulty, for the rapid springing up of all kinds of vegetable existences, in their proper localities, after that great catastrophe? If the soil deposited by the waters of the flood was, to so remarkable an extent, mixed with seeds, as the impregnation of the earth brought up from the depth of 360 feet, and other facts, seem to imply, we shall find little difficulty in accounting for the general diffusion of plants over the face of the earth, each species in the situation suited for its growth, and we shall cease to be astonished that the plants of temperate, and even of Arctic climates, should be found in the higher elevations of the Himmalayah Mountains, the Andes, and other tropical mountain ranges. Among the varieties of seeds thus dispersed and deposited, those exposed on the surface, or within the range of the action of the atmosphere, which were unfit for the soil and climate, would perish, while a single seed, adapted to these conditions, would soon spread over extensive regions.

SECOND WEEK—SATURDAY.

DEVELOPMENT OF SEEDS AND PLANTS.

Many very ingenious experiments have been made by the most eminent chemists to investigate the laws of vegetation,

and to analyze the substances employed or produced in the vegetative process; but so much mystery is still connected with the subject as to render it probable that, beyond a certain point, human ingenuity will never be permitted to penetrate. There are, however, many curious facts, which experiment, and assiduous attention to the subject, have established; and some of the most interesting, and easily comprehended of these, I shall now endeavour to state in a popular manner, abstaining, as much as possible, from scientific details.

In the first place, it has been found that the three great agents in developing the vegetative powers of plants, are water, air, and heat. If any of these agents are absent, the seed will not germinate. If they are present, in certain proportions, the process of germination will, in every instance, proceed through its first stages, without the co-operation of any other substance or property. Now, observe how these conditions are adapted to the state of external nature. The atmosphere with which the earth is everywhere surrounded, is composed of air and watery vapour, the latter of which it gives out, at intervals, in the form of rain, and the former of which exists, in such proportions, as always to be at hand for the purposes required; and, with regard to heat, its presence, at certain periods of the year, in greater quantity than at others, gives rise to all the grateful vicissitudes of the seasons, and exhibits an adaptation full of wisdom and goodness, the nature of which has already been partly considered, and will be still further unfolded as we proceed.

Observe further, that there are two distinct parts of a plant contained, in embryo, in every seed, the one consisting of the root, and the other of the plume or plumale, or what, when developed, is in ordinary language, called the stalk of the plant; and, to the growth and perfection of these, different conditions are required, corresponding to the various functions they are destined to perform. The root is intended to execute two important designs, as has been already observed, the one to select nourishment for the plant, the other to fix it

firmly in the ground; the plume, on the other hand, has to shoot up into the open air, that it may be patent and convenient for supplying the wants of animal life, and may thus fulfil its appointed office in the wonderful economy of nature. Here, again, there is an adjustment, which clearly indicates intention, in the proportions in which the three essential elements are required. The root has to exist beneath the surface of the ground, where, indeed, air and heat, as well as water, exist, but by no means in the same relative quantities as above the surface; but that is a difference precisely suited to the constitution of this part of the vegetable, and indeed, in some respects, essential to its healthy state. And here is another, and still more remarkable adjustment in the difference which exists between the requirements of the root and plume, with reference to external nature: the former demands darkness, the latter light, for its healthy development. The root, having to seek for nourishment under ground, where the solar rays are excluded, is so formed by the All-wise Creator, as to stand in no need of light. It can exist indeed, when exposed to the day, and even, under peculir circumstances, in this situation, can expand vigorously; but it covets darkness, and is, obviously, in its most luxuriant, as well as appropriate state, when the light is excluded. It is not so, however, with the plant itself. It is true, that the vegetative process will proceed even in absolute darkness; and this property is of moment, both because the seed is frequently buried so deep that the plume must make considerable progress in its development, before it emerges to the light of heaven, and also because darkness alternates with light, in consequence of the diurnal revolution of the globe. But light is of essential importance in contributing to the vigour, and to various highly useful, as well as ornamental properties, of plants. 'When deprived of light,' says Dr. Irvine, 'all plants nearly agree in the qualities of their juices. The most pungent vegetables then grow insipid; the highest flavoured inodorous; and those of the most variegated colours are of an uniform whiteness.' 'Vegetables which grow in a

natural situation, burn when dry; but a vegetable bud, in a dark box, contains nothing inflammable.' We have here, in few words, the effect of light on vegetation. To this agent it owes taste, smell, colour, and inflammability; the three former qualities obviously adapted to give peculiar gratification to the senses with which Providence has endowed us; the latter necessary for bestowing upon man that fuel, the use of which at once compensates to him the defective heat of an ungenial climate, and endows him with an amazing power, that enables him to increase his comforts, exalt his enjoyments, and sharpen his faculties, in the advancement of the arts of civilized life.

Another circumstance connected with these properties, is the mysterious principle existing in the seed, by which, in whatever way it is deposited in the soil, it adjusts its position so as to push its plumale upward, and find its way, by the most direct path, to the light of day, while it sends its root downward, and in lateral directions, with obvious, and, as it were, studied predilections in favour of the most fertile soil, and the securest position for the support of the plant. These properties have attracted the attention, and excited the curiosity, of scientific men; and various conjectures have been hazarded with regard to the mechanical or chemical laws by which the opposite tendencies of the different parts of the same plant are regulated. 'These tendencies,' says the author of an elaborate article on Vegetable Physiology, in the Supplement to the Encyclopedia Britannica, 'have been ascribed to the action of light on the plume, and of earth on the radicle; but the radicle equally descends, although no earth be present, and the plume rises although light be excluded. Others have attributed the descent of the radicle to the greater weight of its sap, and the ascent of the plume to the lighter condition of that fluid; but there is no evidence that, in these parts respectively, any such difference of sap exists. More lately, it has been supposed that gravitation acts in causing the descent of the radicle; and attempts have been made to counteract this force, by keeping seeds during their evolu-

tion, in continued motion, on vertical or horizontal wheels; but the results obtained seem only to prove that, in such circumstances, the radicle and plume pursue, as usual, opposite directions, without affording any evidence, why, in natural growth, the one always rises and the other descends.' All this leads to the belief, that the principle, which is attempted to be discovered, lies deeper than human reason can easily penetrate, and is probably involved in the mysterious qualities of vegetable life, which the power of the Creator has infused into organized existences of this order.

But there are various other processes not less remarkable, and scarcely less mysterious. The sap is supposed to rise in the plant, as we have said, partly by means of capillary attraction, and partly also by means of some unknown vital property, supposed to be a contractile power in the vegetable tissue. The temperature of the atmosphere is of essential importance for promoting this process; and, before the formation of the leaf, the sap seems, from various experiments, to rise and fall, or to remain stationary, according to the state of the weather, like mercury in the tube of the thermometer. But, as soon as the plant has expanded its leaves, the sap* flows regularly towards them, and the plant ceases to bleed when incisions are made. The reason is, that, through the pores of the leaves, a constant and powerful perspiration takes place, which throws off the superfluous watery particles of the sap, while the proper food of the plant, contained in the fluid, is, at the same time, retained and secreted. This perspiration by the leaves is much greater than could readily be believed, without actual experiment. Woodward found that a sprig of mint, weighing only 27 grains, imbibed, in 77 days, 2558 grains of water, yet its weight was only increased 15 grains, and it must, therefore, have given off, in that time, 2543 grains of fluid. It is during the transmission of the sap through the leaves, that what remains in the plant re-

* It appears that, about 99 parts in 100 of the sap is pure water, the rest consisting chiefly of acetate of potass, vegetable matter, and carbonate of lime, with the addition sometimes of tannin, alum, sugar, &c.

ceives its peculiar consistence, colour, odour, and taste, differing materially in each species, and hence called the 'proper juice.' 'It is in this proper juice,' says Du Hamel, 'that the narcotic power of the poppy, the corrosive quality of the fig, the diuretic virtue of the fir, and the purgative property of jalap, reside; and even the peculiar products obtained from the sugar-cane and maple, arise probably from the intermixture of the proper juice with the common sap.'

That the extraordinary changes of sap by which plants acquire their peculiar and distinctive qualities take place chiefly in the leaves, seems now to be generally admitted, as well as that the effect is, to the greatest extent, produced by the combined agency of light and air. But here experiment stops short, and philosophy is at fault. Some of the chemical combinations which are produced in the process of vegetation, have indeed been ascertained; but these discoveries have contributed little to the development of the principle on which vegetable life depends; and we must be content with the humbling, but salutary conviction, that 'such knowledge is too great for us; it is high, we cannot attain unto it.' Let it lead us to regard, with more profound veneration, that wonder-working Hand which has, with such consummate skill, combined all the powers of nature into one harmonious whole, and employed them so mysteriously, yet with such obvious wisdom and goodness, to promote the subsistence and enjoyment of the various orders of living beings.

THIRD WEEK—SUNDAY.

ANALOGY OF NATURE.

All nature is fertile in analogies. Points of resemblance, striking and innumerable, may be discovered between the laws and conditions of the animate and inanimate creation,—the world of matter and the world of intelligence. In all

things perceptible by our senses, or the objects of our intellectual powers, may be traced the evident marks of the *same* designing hand. And thus, not only does every department of moral and material nature proclaim the existence of a Deity, but it shows forth, with resistless evidence, the unity of the great Creator.

The analogies now alluded to might be divided into several classes, and named according to the arts, or the objects of human pursuit with which they are connected. First, might be mentioned, those grand, or, it may be, fine and subtle analogies, that so frequently guide the inquiries and influence the conclusions of the philosopher, and which might, therefore, be termed philosophical; then come those beautiful and delicate resemblances that charm the imagination, and minister so largely to poetry, which might properly be called poetical analogies; but a higher and nobler species than either of these would still remain to be described,—I allude to that great and exhaustless class, which we discover, when we attentively compare the volumes of Nature and Revelation, to exist between the kingdoms of Providence and Grace,—between the spiritual and the material worlds. This last would embrace all those moral and religious analogies which every devout Christian traces with such profit and delight.

Spring, above all other seasons, the pleasant theme of the moralist and the poet, is pregnant with analogies that feed the fancy, and awaken to pleasing and serious reflection. Nature now appears to be emerging fresh and beautiful from a gloomy chaos, or at least to rejoice in the gladness of renovated youth. To the poetical fancy her opening blossoms vividly image forth the warm promises of hope; the music, that fills the woods and fields, sounds like the thrilling tones of joy from hearts to which these promises have been fulfilled. The gay and blossoming earth, containing in her bosom the future riches of summer and autumn, is the chosen emblem of youth, which is soon to ripen into manhood's strength and fulness.

But a mind imbued with the distinctive doctrines of Reve-

lation, and which delights to trace the hand of the Great Author of all things in his word and works, perceives, in the operations of this interesting season, a far grander and nobler image; and, in the reviving world, discovers the liveliest material type of the resurrection. Not less wonderful or less inexplicable, is the universal bursting forth of vegetable life from seeming death, than the sudden reconstruction of the long dissolved and mouldering body. When we see, year by year, the most beautiful and stately vegetable forms springing up from minute and apparently decayed seeds and germs, some to flourish in rank luxuriance, others to bear blossoms and precious fruit, can we think it incredible that, in the revolving cycle of Providence, an eternal spring shall arrive, in which immortal forms shall spring from the dust and ashes of the tomb? The God under whose directing and sustaining hand there is an annual resurrection of Nature, has clearly promised the re-animation of our decayed and apparently forgotten bodies. In the one, he gives us a lively and constantly recurring type of the other. Between the annual revival of the earth and the general resurrection, the analogy is striking; and it finely harmonizes with the uniformity stamped on the vast economies of nature and of grace. Before man rises to eternal life, he must pass through the winter of the tomb; he must lie down in corruption before he can rise in incorruption. As the plant loses its bloom and ripened fruit, withers, and disappears from the face of the ground, to spring up in renewed loveliness at the appointed season, so the children of men grow old, and sink into the grave, to rise again, clothed with immortality, at the judgment day.

Yet the analogy is not complete. The tree renews its leaves, or the flower, which, in autumn, died down to the earth, springs again from the root; or the seed which has been scattered in the ground, shoots into life and beauty a new plant; or the insect which spent the winter in a lethargic sleep, awakes, to pass a second time through a series of surprising transformations: and all these wonders forcibly remind us of our own great change, and speak of Him who

brought life and immortality to light. But there is one important particular in which the analogy is defective. These objects revive, or are renewed, to run the very same round as that of the preceding year, to be subject to the same conditions, and to fulfil the same destiny. They but move in a cycle, without progression. It is not the passing from a lower to a higher grade of being,—it is not the exchange of one world for another. The leaf, the flower, the plant, the insect, are still the very same, or, if different individuals, at least of the very same species, existing under the same conditions as in the year before. But it shall not be so with man. At his resurrection he shall be raised a spiritual body; his very material part shall be refined and glorified; and instead of being bound to earth, and subject to earthly conditions, he is destined to ascend into a new and more exalted sphere, and, leaving the bounds of this nether world, with its vicissitude, sorrow, and death, and meeting his Lord in the air, to become an heir of immortality, a denizen of the celestial paradise, an associate of angels, a friend and companion of the Son of God, an adopted child of the Eternal himself.

The analogy, however, though incomplete, is pleasing. It is true that it cannot furnish us with an argument in favour of our future existence, which, indeed, we do not require; but it affords us an agreeable illustration of an infinitely important truth, with regard to which, on other grounds, our faith is firm and confident. Of a similar illustration an inspired apostle has not disdained to make use; and as *he* employs it, it is not only legitimate and complete, but highly instructive. 'That which thou sowest is not quickened except it die; and thou sowest not that body which shall be; but bare grain, it may chance of wheat, or some other grain; but God giveth it a body as it hath pleased him. So also is the resurrection of the dead. It is sown in corruption, it is raised in incorruption; it is sown in dishonour, it is raised in glory; it is sown in weakness, it is raised in power; it is sown a natural body, it is raised a spiritual body.'

May such be the thoughts we cherish at this charming and

critical season. Let us not merely revel in the enjoyment that every sense affords us, as we traverse the reviving fields, and inhale the odorous breeze : Let us not give way to vague feelings of gratitude and delight, and luxurious but profitless musings. Our eyes should not merely be open to the beauty, and our ears to the harmony around us, as if indulgence in animal joy were our sole duty or proper employment, when we hail the opening spring. Be ours the task rather to deduce and apply the moral lesson of the season, and to view the grand renovation going on upon the face of the earth, chiefly in connexion with the sublime christian doctrine, which it so impressively shadows forth. When the eye rests on the innumerable blades of grass, or the countless forest leaves, all unfolded to the light by the reviving breath of spring, let us think of the millions of our mortal race that shall one day, by a more visible but not more powerful exertion of the Almighty arm, arise from among the clods of the valley, to exist in another and never-ending state of being.

And if such be the tenor of our thoughts, can we forget that, after the resurrection, comes the final judgment? In the mind of the Christian these two great events will ever be associated ; and surely they cannot fail to solemnize his soul, and incite him to faithful preparation. If we live and sink into the dust like noxious weeds, having only brought forth the poisonous fruits of unrighteousness, the gloomy winter of the grave will be but a faint emblem of that everlasting darkness and despair which shall be our only portion. But if we fall laden with the precious fruits of faith, with these all-glorious shall we rise, to rejoice in one eternal summer in the paradise of God. J. D.

THIRD WEEK—MONDAY.

THE VITAL POWERS OF PLANTS.

On Saturday, as well as in some former papers,* I have anticipated several observations on the functions of vegetable life; but there are still some circumstances relative to this interesting subject, which have either not been as yet noticed at all, or have been but slightly alluded to, and which yet naturally come under review in considering the physiological condition of plants in spring. To these I shall now shortly advert.

The function of secretion is one of those hitherto inscrutable mysteries which belong to organized life in the vegetable as well as the animal world. By this power, is meant 'the separation of a peculiar matter from the general mass of fluids, by some particular structure, and which may either retain its fluid state or become solid.' The first remarkable circumstance which strikes the inquirer is, that though the mass of fluids from which the secretions are produced be one and the same, and the secreting organs, as to externals, be often in the same condition, yet the matters secreted in these various organs differ greatly from each other. Thus, an essential oil is found only in the rind of the orange, a fat oil only in the kernel of the almond; and so with regard to other secretions, which exist only in particular parts. Besides the acids, alkalis, earths, and metals, which, though of a mineral nature, are more or less constantly found in plants, chemists enumerate about forty products of vegetation, which possess distinct chemical characters; and of many of these products numerous varieties exist. As none of these substances can be detected in the common sap, they must have been elaborated by the specific organs of vegetables, under a process of secre-

* See Papers on the Hybernation of Plants—'*Winter*,' Fourth Edition, pp. 162–177; and on the Balance of the Animal and Vegetable Creation —'*Winter*,' pp. 78–85.

tion. By what peculiarity of structure or of function these organs are enabled to produce such remarkable chemical changes in the common sap is quite unknown; neither do we know how much is to be attributed to the action of the organ itself, or to the reaction of the several ingredients on each other, or to the influence of external agents. From all that appears, however, these changes are necessarily connected with the principle of life, no such effects being ever produced either by experiments on the sap itself, independent of the secreting vessels, or by any extraneous combination of ingredients.*

Of all these products of secretion, the most remarkable, and the most important to the plant, is a mucilaginous fluid named *cambium*, which is employed directly in vegetable nutrition and growth, and may be considered as analogous to chyle in animals. This substance is formed directly from the proper juices, which, again, are formed from the sap; and though these differ from each other very widely in different plants, as to their sensible and chemical properties, the cambium seems, in all plants, with regard to these, to be nearly the same. It is without colour, odour, or taste, though the proper juices exhibit all these qualities. The proper juices, also, are contained in the vessels, and flow out when they are divided; but the cambium transudes rather than flows, and that only in places where new parts are to be formed. Thus, in the pine, says Mirbel, while the proper, or resinous juice, flows in the large vessels, the cambium transudes beneath the *liber*. Of the other secretions of plants, which are found

* It is a curious fact, that some of the substances most essential to the nutriment of plants, though differing very materially in their sensible qualities, are, on chemical analysis, found to be composed of precisely the same constituent parts, united in proportions, but slightly differing from each other. Thus, Dr. Prout gives the following analysis of the relative composition of gum, starch, sugar, and lignim:

1000 parts of gum arabic, yield.....585 of water, and 414 of carbon.
of dried starch, or facula..560.....440
of pure crystallized sugar..572.....428
of lignim, from boxwood....500 500

chiefly on the external parts, such as the leaves, flowers, fruit, &c., the number and diversity are very great, some of them calculated to delight the sight, the smell, or the taste; and others of the first utility in the arts, or in contributing to the subsistence or comfort of animal life.*

This slight notice of the phenomena of secretion, is sufficient to fill the mind with wonder and devout admiration in reflecting on the attributes of the Creator, exhibited in this familiar but most mysterious operation, by which the surface of the earth is replenished with food fit for the nourishment of living beings, adorned with beauty, and rendered fruitful of blessings. First, the sap is collected from the crude earth, consisting of common water, holding in solution a few well-known substances, which the soil abundantly supplies. This fluid is then carried through capillary tubes to the leaves, where it is, by some obscure chemical process, in which the light, heat, and gases of the atmosphere combine their secret powers, converted into a peculiar juice, corresponding to the constitution of each species of plant, and, in different species, possessing different and sometimes directly opposite qualities; such are volatile and fixed oils, resins, gum-resins, balsams, turpentines, tannin, and extractive, with alkalis and acids, earthy and saline compounds, &c. From this peculiar juice, again, are secreted substances, possessing apparently none of its characteristic properties which perform various important functions, and one of which is destined to form the particular tissue of the plant that exudes it, and to become, indeed, part of its substance,—thus, at one time moulded into the gnarled limb of the oak, and at another into the tender and pliant twig of the willow.

I cannot, without deviating too far from the popular plan of

* Supplement to Encyclopedia Britannica,—article Vegetable Physiology. M. Mirbel has lately made some observations on the cambium of vegetables, in which he confirms the opinion of Grew and Du Hamel, that all vegetable tissue has been cambium at first, or that mucilaginous matter, of extreme delicacy, which he, in other terms, names cellular mucilage.

this work, enter more minutely into the physiology of vegetable substances; but there is one well-known effect of the process of vegetation which I may just allude to, in order to call the reader's attention to a very remarkable adaptation with which it is connected. Dr. Priestley made the discovery, that oxygen gas is exhaled from the leaves of plants during the day, and the investigation which he commenced has since been continued by others,—the result of which is, that a species of respiration in plants has been ascertained, depending on the alternations of day and night, which is essential to their vital powers, the oxygen exhaled during the day being inhaled in the night. This affords us a new analogy between vegetable and animal existences, which is not a little curious; but let it be observed, that the object to be answered by this vegetable respiration, is exactly the converse of that which is answered by the breathing of animals; in the former, it is that of adding carbon, in an assimilated state, to the plant; in the latter, it is that of discharging the superfluous quantity of carbon from the animal.

There is something exceedingly worthy of remark in the fact just mentioned, as it exhibits a very unexpected, but most interesting view of the kind of action and reaction which goes on between the vegetable and animal creations, and of the salutary balance which is thus kept up in the two organized kingdoms. The oxygen exhaled during the day, completely compensates for that which was inhaled during the night; and, in whatever degree the atmosphere has been deteriorated, in its capability of sustaining animal life, by the discharge of carbonic acid from the lungs of animals, the demands of vegetable life for that injurious substance, tend again to restore it to a healthful state. 'The oxygen given out by plants,' says Dr. Roget, 'and the carbonic acid resulting from animal respiration, and from the various processes of combustion which are going on in every part of the world, are quickly spread through the atmosphere, not only from the tendency of all gases to uniform diffusion, but also from the action of the winds, which are continually agitating the

whole mass, and promoting the thorough mingling of its different portions, so as to render it perfectly homogeneous in every region of the globe, and at every elevation above the surface.'

Looking at the whole subject of vegetable physiology, even in the very imperfect outline of it which has now been traced, it is impossible not to recognize the Designing Hand of infinite power, wisdom, and goodness. The processes are so astonishing, the results so beneficial, and the adaptations so skilfully adjusted, that the man must be wilfully blind who does not see, in them all, the presence of a Father-God. Were but one of these to fail, or be deranged, disorder and destruction would inevitably ensue. And yet most of the changes and combinations of organic life are of the most delicate nature, depending upon conditions which a very slight deviation on either side would render nugatory; thus reminding us, continually, of the wisely regulated balance which the Creator has established, and sedulously preserves,—and teaching us the lesson of constant dependance on His providential care.

THIRD WEEK—TUESDAY.

FLOWERS.—THEIR FORM, COLOUR, AND FRAGRANCE.

The variety which exists in the vegetable world is an example of a quality which pervades all nature, and stands forth in each of its departments as a very conspicuous feature in the character of creation. There is a continued chain of existence, commencing with the most crude materials, and passing from earth, rocks, and metals, to the more subtle elements which compose water, air, and light; and thence again to vegetable productions, rising through the various tribes of mosses and fungi, to grasses, shrubs, and trees, till Nature combines all that is beautiful and delightful in this department of her works, in the formation of flowers. These,

though comparatively minute productions, yet contain in their construction, both as regards its appearance and its uses, so many proofs of beneficent intention, that there seems no part of the vegetable world which presents, in so concentrated a form, such varied evidences of a Divine Hand.

'Flowers may be regarded not only as the last, but the most elaborated organs of the vegetable system. Whether we contemplate the beauty of their forms, the splendour of their colours, or the delicious fragrance they every where breathe around us; or whether, with a physiological eye, we survey the delicacy of their structure, and investigate the peculiar functions they perform, we cannot but feel the greatest admiration of the skill with which, in a compass so small, and by means apparently so simple, such a series of actions, terminating in results so varied and important, can at once be combined and regulated.'* In this short but comprehensive description, two intentions of Creative Intelligence are indicated, the object of the one being to afford a source of innocent gratification to the senses, and that of the other, to contribute to some useful purpose, either in the economy of the plant itself, or as respects the animal creation. To the first of these objects, the attention of the reader shall be at present directed.

As a mere source of innocent gratification to the senses, flowers seem to be formed almost exclusively for the benefit of man. He alone, of all sentient beings, appears peculiarly formed to derive pleasure from a sense of the graceful and beautiful, or from the perception of a delicious perfume. The eyes of other animals are often even more acute than those of the human species, in distinguishing between what is hurtful or nutritious in their food, or in discerning between friends and foes, and in other means of self-preservation; while, to the same objects, their olfactory nerves are remarkably alive; and, doubtless, with the exercise of these instinctive or acquired feelings, much of the enjoyment of their lives is connected; but to those delicate sensations, connected, in some degree,

* Supplement Encyclopedia Britannica, Art. Vegetable Physiology.

with the mental faculties, and heightened by agreeable associations, which arise from the brilliancy and harmony of colours, from elegance of form, and from sweetness of odour, they seem to be in a great measure insensible. That there may, however, be a slight degree of enjoyment in some of the lower animals, arising from a bright colour, or a pungent smell, independent of the feelings already mentioned, I am not inclined to deny; but, in extent, and probably also in kind, it is certainly far inferior to the enjoyment derived by the human race from these sources; while, of the faculty which discerns the beauty of form and proportions, they appear to be wholly destitute.

On what principles in the human frame, either bodily or mental, these sensations depend, I shall not stop to inquire. Some very elaborate and ingenious treatises on taste, and the perception of beauty, are in the possession of the public; but it is sufficient for us at present to know the fact, that such sensations exist, and that they contribute in no trifling degree to the elegant enjoyments of human life, increasing and becoming more exalted in proportion to the progress of mental refinement. Assuming, therefore, the existence of these pleasurable feelings, of which every person must be sensible from his own experience, I am entitled to adduce the form, colour, and fragrance of flowers, as an instance of benevolent adaptation of a very remarkable, and, at the same time, a very satisfactory kind. The mind of man being made capable of deriving pleasure from certain forms and proportions in objects of vision, we find the very forms and proportions best calculated to excite this pleasure impressed in great variety on the multitudinous races of flowers. Their stalks, their leaves, the shape of their petals, are, in the vast majority of instances, such as to afford an agreeable sensation to the beholder, by gratifying that peculiar faculty which is known by the name of taste. A similar observation may be made with regard to the colour of flowers. The delicacy or brilliancy of their hues, the softness of their shades, the variety of their tints, sometimes contrasted, sometimes harmonizing, but almost al-

ways agreeable, prove, in the most satisfactory manner, design and adjustment between these appearances and the susceptibility of pleasure in the human mind. It cannot be said, with regard either to form or colour, that they afford indiscriminate gratification; for the mind is as capable of disgust from certain forms, and certain combinations of colours, as of enjoyment from others. There is in the case of flowers, therefore, an obvious selection of the agreeable, and rejection of the unpleasant, in both these particulars, which can only have proceeded from a desire in the Creator to communicate enjoyment.

A precisely similar mode of reasoning will prove benevolent design in adding fragrance to the other delightful properties of flowers. There seems no reason, in the nature of their constituent parts, why flowers should emit any smell at all; or, if they did, why that smell should be a sweet and grateful odour, rather than the reverse; but, in reference to the intention of an Intelligent Creator, the reason is obvious. It is one of the means by which Divine Benevolence enlarges the sphere of enjoyment to his rational creatures.

Nor must we forget, that the very union of all these agreeable properties in a whole class of vegetable productions, is itself an additional proof of kind intention in the Creator. Had only one of such qualities belonged to an individual species, while in other respects its properties were repulsive; had symmetry of form, for example, in one class, been accompanied with an unsightly colour, or a disagreeable scent; and, in another, had beauty of tints, or sweetness of fragrance, been united with deformity of figure, the pleasure would have been greatly diminished, if not totally counteracted. But the opposite of this usually occurs; and in such grouping of various agreeable properties, not naturally combined, we once more perceive an evidence of paternal care. This, again, is rendered still more palpable by the bountiful profusion, and inexhaustible variety, with which flowers are scattered on the green lap of spring. Wherever we wander, —in lawn, or field, or wood, or glade, over swelling hill, or

low-lying meadow, these gems of vegetation, in all their diversified loveliness, from the 'wee, modest, crimson tipped flower,' to the lily of the valley, arrayed in chaster beauty than Solomon in all his glory, as they spring up beneath our feet, arrest our gaze, and excite our admiration.

I persuade myself that it is not possible for any candid mind to resist the conclusion which flows from these combined particulars, that there is a Being of matchless skill, and condescending goodness, whose Hand may be traced even in the wild flowers of the desert; and whose perfections are not the less admirable, that He has lavished them on objects so minute and insignificant, and has cared, even in such comparatively unimportant matters as appearance and perfume, for the innocent gratification of his rational offspring. It is true, indeed, that we sometimes meet with a flower of a shape or odour which excites disagreeable sensations; and this is quite in accordance with the analogy of nature in a world where every thing is intended to remind us that we are fallen creatures, existing for a time in a blighted world; but in this, as in other departments of nature, benevolence vastly predominates, and a Father's care is conspicuous. It was not without reason that Mungo Park, in an hour of despair, was reassured by the sight of a little flower, looking forth in its loveliness from the soil of the wilderness; and that he received energy to effect his deliverance, by reflecting on that beautiful and comforting sentiment uttered by the Divine Saviour, 'If God so clothe the grass of the field, which to-day is, and to-morrow is cast into the oven, shall he not much more clothe you, O ye of little faith?'

THIRD WEEK—WEDNESDAY.

FLOWERS.—THEIR ORGANS OF REPRODUCTION, AND THEIR SECRETION OF HONEY.

Besides the properties of form, hue, and fragrance, which I noticed yesterday, as belonging to flowers, these lovely and

curious productions are made to perform some highly important functions as respects the economy of the plants themselves, as well as in reference to the animal world.

The corolla—or, in popular language, the flower—surrounds those delicate organs on which the reproduction of the plant depends, and consists of one or more petals, which are placed within a calyx, or flower-cup, generally of leaflets. Its physiological use is various. Its petals are found to abound in air-vessels, and to form carbonic acid gas, though they do not decompose it, like the leaves; and hence they have been called by Dr. Darwin, the lungs of the generative organs, while the leaves may certainly be held to perform to the rest of the plant a function analogous to that of lungs. The best ascertained office, however, which the corolla executes, is that of protection to the organs of reproduction, which are enclosed by it. For this purpose it is obviously contrived. Amidst the most striking elegance and variety of shape in the different species, this function is never lost sight of. It opens its bosom to the sun, and sometimes turns towards him, and follows his course as he moves through the heavens, or, more frequently casts its look directly upwards, that it may receive its vivifying rays from whatever quarter he shines. It is often so formed that it may wave in the wind, to favour the prolific process by its agitation, and that it may turn away its face from the blast, when it would breathe too roughly on the precious charge. In the evening, or in rain, or even sometimes when the sun is obscured by clouds, if the parts it guards are so delicate as to be injured by the cold or wet, it carefully shuts its petals, to open them again whenever the cause of alarm is removed;* in all these operations exhibiting a very interesting proof of paternal care in the Creator.

With regard to the reproductive organs themselves, the same care is displayed. By a series of very striking contri-

* During the annular eclipse of the sun on May 15, 1836, which happened not long after mid-day, while that luminary was shining in full power, flowers were observed to shut their leaves, and some of them reopened when the eclipse was over.

vances, differing materially in different kinds, and, in all these varieties, affording new proofs of Designing Wisdom, the continuance of the species is secured, while individuals perish: and thus the principle which pervades all organized existences, of alternate decay and revival, is provided for. The analogy of nature, too, in the mode of this, as well of other processes, is remarkable. As in the animal, so also in the vegetable world, the reproduction of the species is effected by means of organs called male and female,—barren when kept separate, but rendered fertile by their union. The male organ has obtained the name of stamen, that of the female the name of pistil.* From the Edinburgh Encyclopedia the following account of their functions is abridged.

Botanists are now generally agreed as to the real nature and extent of the offices which the stamens and pistils are destined to perform in the economy of Nature. Linnæus has the distinguished merit of having clearly and satisfactorily established that they are organs essential to the propagation and perfection of the fruit. The proofs adduced in favour of this opinion are highly satisfactory. Every one must have observed that the flowers precede the fruit, and this holds true throughout the whole classes of plants. Now, all flowers are furnished with both stamens and pistils, either in the same individuals, or in two distinct individuals of the same species. This fact has been ascertained in the most minute examples, even in mosses, which were long supposed anomalous. Ferns form the only apparent exception; and it is highly probable, from general analogy, that these parts, though still concealed, have existence in that order. The most decisive proof of the

* The following is a more particular account of the organs of reproduction. The germ is lodged in a vessel called the *ovary*, or seed-vessel. From its summit rises a little thread-like stalk, called a *style*, which, at its extremity, supports a small spongy substance, denominated the *stigma*. These three form a whole, which bears the name of *carpel*. Immediately surrounding the *pistils* are situated the *stamens*, each of which consists of a slender filament, supporting a little bag or case, called an *anther*, filled with *pollen*, which is a species of dust or powder. The anthers, when ripe, burst, and shed their pollen upon the stigma.

necessary agency of the stamen on the pistil, for the production of the perfect fruit, is afforded by the very well-known experiment made in 1749, upon a small palm-tree at Berlin, which, for the want of the neighbourhood of a male tree, had never brought any fruit to perfection. A branch containing male flowers was sent by post from Leipsic, a distance of twenty German miles, and suspended over the pistils. Subsequently abundance of fruit was ripened, and many young plants raised from the seeds.* Another instance, still more remarkable, but, from the nature of the case, less capable of being distinctly established, is mentioned by some authors, relating to two remarkable palm-trees in Italy. The one, situated at Otranto, had no stamens; the other, at Brindisi, which is about forty miles distant, had no pistils; and, consequently, neither of these trees bore seed. But when, after the growth of many years, they not only rose superior to all the trees of the neighbouring forests, but overtopped all the buildings which intervened, the pollen of the palm-tree at Brindisi, was wafted by the wind to the pistils of that of Otranto; and to the astonishment of every one, the latter bore fruit.†

It is remarkable that in flowers which possess both the male and female organs the stamens are, with very few exceptions, shorter than the pistils in drooping flowers, and longer in those that are erect; evidently destined, in both cases, to favour the influence of the pollen. Many other curious and beautiful means are employed to promote the due application of the pollen to the stigma. In some plants, such as the *Parnassia*, the stamens successively lean over the stigma, and deposit the pollen; others are invested with a power of consentaneous junction between these parts; others are connected with a membrane, which contracts and dilates according to the state of the atmosphere. Some stamens possess a considerable elasticity, by which means the pollen is projected upon the stigma; in other flowers the germen has a cur-

* Edinburgh Encyclopedia, article Botany, pp. 67, 68.

† Fifth Book of Lessons for the Use of the Irish National Schools.

vature endowed with an elasticity which brings it into contact with the stamens.

Bees, and other insects, are frequently the agents in fertilizing the stigma. The object of the animal is to obtain honey; and while in quest of it, his hairy body collects the pollen from the male flower, and communicates its influence to the female, during some subsequent search. If it be true as is said, it is not a little singular that these insects, which are not confined to a particular species of plants, fix upon one species during the course of each day. In those flowers which require their agency, hairs are usually placed in such a situation at the entrance of the flower, as not only to exclude the wet, but also to compel all insects that enter it to pass over the stamens. The intervention of insects is strikingly displayed in the *aristolachio climatitis*, the flower of which always remains in an erect position, although the stamens are shorter than the pistils, forming an exception in this respect, to the general rule; the consequence of which is, that the pollen falls to the bottom of the flower, where it would remain useless, as has been proved by experiment, were it not for these living agents. Many particulars are recorded by Keolreuter and Springel, of the means by which different insects are made unconsciously to accomplish these ends, exhibiting a new series of creative adaptations between the animal and vegetable worlds; but though these are exceedingly interesting, I cannot at present stop to enter on them.

The last function of flowers which I shall notice, relates to their use to the insect tribes, already incidentally hinted at. The nectaries of flowers seem to be intended by Providence for the secretion of honey, that well-known and delicious substance, which forms the food of the bee and numerous other insects. From the position of this organ at the bottom of the corolla, and below the parts of reproduction, the intention of which, at least in some instances, we have already seen, it is not easy of access, and would indeed frequently be altogether inaccessible, had not the same Divine Hand which laid up the precious store for them, furnished

them with peculiar instruments, with which, after finding their way to the bottom of the deep cup, they can pump up their food—another pleasing instance of adaptation between the animal and vegetable worlds.

A pious acquaintance, remarkable for the quaint shrewdness of his observations, having one day pulled a primrose from a hedge side, after expressing his admiration of its simple beauties, took up a clod in his other hand, and naïvely, but emphatically exclaimed, 'What but Almighty power could extract *that* from *this?*' If there was any thing ludicrous in the manner there was nothing but truth and sublimity in the sentiment. Every thing in the operations of the Creator is worthy of devout admiration; but I scarcely know any thing in the inanimate world, which brings together and concentrates so many wonders of designing wisdom and benevolence, as the structure and qualities of a flower;—and assuredly not a little is added to the surprise and pious feeling with which this delightful production is contemplated, when we think of the crude materials from which it is elaborated. The beauty of form and colour; the sweetness of the fragrance; the delicate and skilful nature of the organization; the careful provisions, the forethought, the contrivance, the suiting of parts, as regards the propagation of the species; the adaptations to the subsistence and enjoyment of the insect tribes—all produced by the artificial union of a few simple and apparently unfit substances, cannot fail to excite in the reflecting mind the most lively sentiments of astonishment, and to force upon it the conviction, that here, without doubt, is the finger of God.

THIRD WEEK—THURSDAY.

THE VIOLET.

To attempt to particularize the various beauties of that profusion of flowers which Spring scatters around us, would be

altogether inconsistent with the nature of the task I have assigned myself. An individual instance must suffice, and with that, a friend, to whom I am indebted for several other interesting papers, has been kind enough to supply me.

All who delight in finding a beauty and a meaning even in the wildest flowers, must have often hailed with the liveliest pleasure that flower of flowers, the exquisitely formed and scented violet. By the dusty wayside, by the green border of the brook, or on the sequestered woodland bank, this universal favourite gives its delicate blossoms to the breeze, recumbent on a mossy bed, or modestly peeping forth from the rank herbage and weeds. As it is a creeping plant, and throws out runners which take root in the soil, and form new stems, it is most commonly met with in beds that make the whole bank or mound odorous and beautiful. Sometimes, however, we find, by the retired footpath, or on the lonely hillside, a single flower blooming alone, the survivor, perhaps, of its fragrant compeers, or the forerunner of a numerous progeny. Then occur the beautiful lines of the poet:—

'A violet by a mossy stone,
Half hid from human eyes;
Clear as a star, when only one
Is shining in the skies.'

The stalks of the wild sweet violet are round, of a green colour, and creep along the surface of the ground, seldom becoming erect. The leaves are also green, and rather large for the size of the plant. They are shaped like a heart, are slightly indented round the edges, and usually hang down in a drooping posture. The flower consists of five petals or leaves, and presents in various mixtures every variety of yellow and blue. A delicate purplish tinge, which it sometimes assumes, adds greatly to its beauty and richness. Four of the floral leaves are disposed in the form of an oblong, the fifth projecting from one of the longer sides, in the direction of the ground. The whole flower is defended by a five-leaved *calyx*, or cup, and hangs down from the gracefully bent stem, a perfect emblem of modest loveliness.

We all admire the beauty of the violet, and delight in its perfume. We are also familiar with its praises, and with its moral and poetical associations. But, while we feel and own the poetry of the flower, have we ever reflected on the admirable specimens of Creative Intelligence which it furnishes, and the numerous beneficial purposes to which it is subservient? Let us attend to the mode in which its seed is protected and spontaneously sown. This seed is formed in a *capsule*, or seed-vessel, with three valves, each containing about an equal number of the tender germs. During the process of ripening, the seed-vessel hangs in a perpendicular position, and is defended from any excess of moisture by the natural umbrella of the calyx. When the seed is nearly ripe, the containing vessel shrivels and begins to open, and, from the shrinking and consequent erection of the stem, the whole apparatus gradually assumes an upright position, in which the capsule, instead of being shielded by the calyx, is supported by it. But why, it may be asked, should not the seed fall at once from the opening vessel without being elevated to an upright and higher position, where its timely dispersion appears to be a matter of greater difficulty? Let us not judge hastily, but inquire further into this interesting subject. From the gradual evaporation of moisture, the sides of the valves shrink and roll up, and the sharp edges of each, at this stage, pressing upon the contained seeds, bring them, though previously arranged in a very irregular manner, into nearly a straight line. Each seed is of an oblong shape, and is hard, smooth, and shining; and hence, when the infolding edge of the shrivelling valve presses upon it, and slides down behind it, the pressure throws it out with a jerk to a distance proportioned to its elevation above the ground. Now may we see the reason why, previous to the scattering of the capsule's contents, that vessel is considerably elevated, as by a mechanical agency contrived for the purpose. The seeds, projected from an increased elevation, are dispersed through a wider circuit, and thereby more effectually fulfil the object of their formation. With such wonderful skill is the mechan

ism of a single flower constructed, and with such admirable precision does it accomplish all its purposes Thus, also, do flowers not only charm the eye, and inspire poetic emotion, but, marvellously contrived, as well as clothed with beauty and perfume, they furnish the understanding with objects worthy of its highest powers. Their structure displays the infinite skill, no less than their outward attractions, the benevolence of the Creator. Surely the knowledge of those arrangemen's, by which the seed of the violet is perfected and dispersed to most advantage, must greatly enhance its matchless sweets in the eyes of every intelligent lover of Nature.

The violet is not without its utility in the economy of the natural world. That a thing exists is sufficient of itself to prove to every pious and philosophic mind that it is useful: but in the case of this much observed flower, we can easily show a few of its specific uses. The caterpillars of several species of butterflies, feed exclusively upon its stalks and leaves during summer; and caterpillars, destructive though they be, and often fatal in their ravages, are yet subservient to the wise purposes of preventing the excessive propagation of certain plants, and of feeding numerous tribes of birds. In winter the stalks afford a secure deposit for the grub of a gall-fly, the insect that produces the oak-galls, so valuable in commerce. In the course of the summer or autumn, the fly lays its eggs on a growing violet-stalk, and the young grubs, as soon as they are hatched, eat their way into the interior, where they find food and protection till the warm weather arrives. The ascending juices being interrupted by their operations, the stalk swells around them to a considerable thickness; but by this disfiguration of the plant, their food is only the more increased, and they are better secured against the cold. On the return of summer, they bore their way out of their vegetable prison, and make their escape in the adult shape of flies.

The violet, like most other plants, may be employed in medicine. It is deservedly a favourite in every rustic pharmacopeia. An excellent syrup is made from its flowers; its

dried leaves furnish us with numerous useful decoctions and ointments; and an infusion of its seeds operates as a remedy for several severe diseases. Thus it is full of healing virtue, in addition to its other useful properties.

Now, the violet is but a specimen of the innumerable wild flowers that adorn the exuberant lap of Nature, and pour forth their treasures to man, while they feed his eye with the purest delight. Were human labour wholly to cease in respect to flowers, and the garden and flower-bed henceforth to lie desolate, still would every sunny and shady nook teem with glowing and perfumed blossoms,—still would the loneliest wilds be crowned

'With luxury of unexpected sweets,'

and exhibit the most delicate specimens of the beautiful, traced by His hand, who is himself the perfection of beauty. Boundless are the vegetable stores with which the earth is strewn; and their extent is only equalled by their utility and loveliness. They all proclaim a great and benevolent Creator:—the majestic oak and the lowly violet of the vale, utter one harmonious voice of praise. Our duty is to listen to that voice with joy, and add our own intelligent adoration.

J. D.

THIRD WEEK—FRIDAY.

THE ANIMAL STRUCTURE.—CELLULAR TEXTURE—MEMBRANES, TENDONS, AND LIGAMENTS.

Reserving to the subsequent seasons what yet remains to be said of the varieties of the vegetable creation, let us now turn our eye on the animal kingdom. The functions of animated nature differ from those of vegetation, not merely a the higher energies of sentient beings, but in other circumstances of their condition, suited to their more exalted station in the scale of existence. Vegetables are fixed to a spot from which they derive their nutrition, and where their reproductive powers are called into action; and to these purposes alone, if we except their relation to the animal world, their structures are adapted.

But, besides the powers of nutrition and reproduction, the faculty of volition, and those of personal enjoyment and suffering, belong to animal life. The exercise of these qualities required a greater range of space; and accordingly, animated beings,—those of them at least in whom such powers are fully developed,—are not attached to a single spot, but are formed capable of locomotion. This change of condition rendered various corresponding changes necessary in their organization; and it is exceedingly edifying to observe the nature of these changes, as manifesting at once unity of purpose, and most skilful adaptation to circumstances, in the universal Creator.

'The element,' says Dr. Roget, 'which we recognize without difficulty, as composing the greater portion of animal structures, is that which is known by the name of the cellular texture. Although bearing the same designation as the elementary material of the vegetable fabric, it differs widely from it in its structure and mechanical properties. It is not, like that of plants, composed of a union of vesicles, but is formed of a congeries of extremely thin laminæ, or plates, variously connected together by fibres, and by other plates, which cross them in different directions, leaving cavities or cells. These cells, or rather intervening spaces, communicate freely with one another, and, in fact, may be considered as one common cavity, subdivided by an infinite number of partitions, into minute compartments. Hence the cellular texture is, throughout, readily permeable to fluids of all kinds, and retains these fluids in the same manner, and on the same principle, as a sponge.'*

This texture is not only flexible in all directions, but highly elastic, and is thus admirably suited to the purposes of locomotion, to which the vegetable tissue could not be advantageously applied, as the nature of its formation, while it admits, indeed, of very considerable flexibility in the direction of its breadth, and also to a certain extent, of elasticity and the power of extension, is yet comparatively rigid in other

* Bridgewater Treatise on Animal and Vegetable Physiology, vol. i. p. 99.

directions. The properties of flexion and extension, existing in the animal texture, are variously modified and adjusted, to suit the exigencies of the case. 'When, for instance, different parts require to be moveable on each other, the cellular substance interposed between them, has its state of condensation adapted to the degree of motion required; that which connects the muscles, or surrounds the joints, and all other parts concerned in extensive action, has a loose texture, being formed of broad and extensible plates, with few lateral adhesions, and leaving large interstices; while, in the more quiescent organs, the plates of the cellular substance are thin and small, the fibres short and slender, and their intermixture closer and more condensed.' The quality of elasticity, again, not only resists the displacement of parts, but, when displaced, causes them to possess a tendency to return to their natural position, and that in a degree, and to an extent, which is neither required nor possessed in the vegetable mechanism.

When it is necessary to interpose a barrier to the transmission of fluids, this is effected by *membranes*, which are merely 'modifications of the same material, spread out into a continuous sheet, of a closer texture.' These furnish strong coverings for the investment, the support, and the protection of all the important organs of the body.

Such membranous textures are also employed in forming tubes for conducting fluids, which, in the higher classes of animals, traverse the body in innumerable canals, and which, when uniting into trunks, or subdividing into branches, are called vessels. The fluids contained in vessels are never stagnant, but are almost always carried forward in one constant direction. For preventing the retrograde motions of fluids passing along these canals, recourse is had to the beautiful contrivance of valves. The inner membrane of the vessel is employed to construct these valves; for which purpose, it is extended into a fold, having the shape of a crescent, and fixed, by its convex edge, to the sides of the vessel, while the other edge floats loosely in its cavity. Whenever the fluid is impelled in a direction contrary to its proper course, it

raises the loose edge of the valve, which, being applied to the opposite side of the canal, effectually closes the passage. On the contrary, it presents no obstacle to the natural flow of the contents of the vessel, both edges being then closely applied to the same side. Frequently two, or even three, valves are used at the same part, their edges being made to meet in the middle of the passage, like the flood-gates or locks of a canal. Among the numberless instances of express contrivance, which are met with in the examination of the fabric of animals, there is perhaps none more striking and more palpable than this admirable mechanism of the valves.

To this general sketch of the fleshy and membranous structure of animals, I may add that of *ligaments* and *tendons*, some of which are elastic and extensible, while others resist extension with great force. The former, consisting of twisted fibres, are generally employed for the support of heavy parts, which require suspension, such as the necks of quadrupeds which stoop to graze;* the latter, which are most artificially contrived, by the interlacing and knotting together of fibres, are applied to the purposes of connexion, where motion is to be restrained. Nothing can be more remarkable than the ingenuity, if I may be allowed to use the expression, of these contrivances, and the adaptation of their mechanism to the purposes to which they are respectively applied. The precise degree of tension, of strength, of elasticity, or the contrary, which the function required, has been apportioned with the most perfect skill; and it is impossible to examine these structures with a scientific eye, and not acknowledge that there is a wisdom here, which art may imitate, but can never equal.

* This ligament is what butchers call the *pax-wax*. Dr. Paley is mistaken, when he says, that these elastic ligatures are peculiar to the necks of quadrupeds. They are frequently employed in the human frame. 'The student,' says Sir Charles Bell, 'who hangs his head over his book, enjoys the advantage of this elastic support; so that it is strictly a matter comparative. We may trace it with increasing strength, from the ligament which sustains a man's head, to that which, like the spring of a steel-yard, weighs against the immense head of the elephant.'

THIRD WEEK—SATURDAY.

THE ANIMAL STRUCTURE.—SECRETION—DIGESTION—AND THE CIRCULATION OF THE BLOOD.

There is another property of animal life, which, on account of its universal application, and its absolute necessity, seems to demand some notice in these preliminary sketches; —I mean the function of *secretion*. This capability of effecting chemical changes in the crude materials received into the body, I have already described as existing in vegetable life; but, in the animal frame, it is much more extensive and powerful. The food of plants is drawn directly from the soil in which their roots are placed, and the atmosphere with which they are surrounded, and consists of simple combinations of elementary bodies, which secretion converts into the various products that their wants require. From this process, the tree receives its leaves, its pith, and its woody fibres. Whatever is peculiar to the species is also derived from the same source. The sweet perfume and delicate hues of the flower, the oil of the olive, the milk of the cocoa-nut, the sugar of the cane, the narcotic juice of the poppy, the nutritious farina of the cereal tribes, and the poisonous extract of the nightshade, are all elaborated by the same mysterious process, and from similar, if not the very same, materials.

In the animal world, the secreting power is carried to a still more wonderful extent, and is applied to a far greater variety of purposes, corresponding to the more complicated and delicate organization of the frames it is destined to support. One remarkable condition of animal food is, as already noticed, that it shall have previously either formed a portion of some other organized being, or, at least, have been a product of organization; and hence the use of the vegetable creation to animal life. But, though no inorganic substance, perhaps, can be considered as capable of affording food directly to the higher order of existences, there is scarcely any animal or vegetable matter, however dense its texture, or virulent its qualities,

which is not convertible, by the power of digestion and secretion, into nourishment for some one or other of the various species of animals. The very venom of the rattlesnake is harmless in the human stomach, and the acrid matter of cantharides, which so readily blisters the skin, forms the natural food of some species of insects.

The various processes by which animal nutrition is carried on, are exceedingly curious, and full of edification, as indications of Creative Intelligence. As the food is not to be received now directly from the soil by means of roots, a mouth is provided, through which it is conveyed, after mastication, into the stomach, where it undergoes the process of digestion. It is thus converted into a pulpy substance, called *chyme*, by the chemical properties of the *gastric juice*, a secretion from the coats of the stomach. Hence it is carried into the intestinal tube, where, by being subjected to further chemical agents, it undergoes a new transformation into *chyle*,—a fluid perfectly bland, and unirritating in its properties. It has now been brought into that precise state of composition, which renders it fit to be distributed to every part of the system, for the purposes of nourishment. From the inner surface of the intestines, the chyle is absorbed by the lacteals, which commence by very minute orifices, in incalculable numbers, and unite successively into larger and larger vessels, till they form trunks of considerable size. They pass between the folds of a very fine and delicate membrane, called the mesentery, where the chyle undergoes the action of certain glands, in which it is supposed to receive some additional modification by the secreting process, preparatory to its conversion into blood. It is then conducted into a common receptacle, whence it ascends, through the thoracic duct, along the side of the spine, till it passes into the great veins leading directly to the heart. It is now blood, and, by the remarkable apparatus of the heart, which I must not stop to describe, is propelled into the general circulation, and conveyed to every part of the body, being, in the higher species, aerated in the lungs, to complete the necessary change, to restore its vital properties

when these become contaminated, and probably to assist, by the decomposition of the atmosphere, that animal warmth,* so essential to the various processes of life. It is during this circulation, that those actions of secretion take place, by which every part of the animal frame, however diversified, is nourished, developed, and repaired. 'All the modifications of cellular substance, in its various states of condensation,—the membranes, the ligaments, the cartilages, the bones, the marrow; the muscles, with their tendons; the lubricating fluid of the joints; the medullary pulp of the brain; the transparent jelly of the eye;—in a word, all the diversified textures of the various organs, which are calculated for such different offices, are derived from the same nutrient fluid, and may be considered as being merely modified arrangements of the same ultimate chemical elements.'†

This series of preliminary observations on the animal functions, may be fitly concluded in the words of an author, whom I have chiefly consulted in the physiological department of my subject. 'Although the order in which the constituent elements of organized products are arranged, and the mode in which they are combined, are entirely unknown to us, we can nevertheless perceive, that, in following them successively from the simplest vegetables to the higher orders of the animal kingdom, they acquire continually increasing degrees of complexity, corresponding, in some measure, to the greater refinement and complication of the structures by which they have been elaborated, and of the bodies to which they are ultimately assimilated. Thus plants derive their nourishment from the crude and simple materials which they absorb from the earth, the waters, and the air that surround them,—mate-

* That animal warmth has been accounted for by the combination of oxygen with the carbon of the blood, which takes place in respiration, occasioning heat, as in actual combustion, where a similar process occurs, and being diffused over the body, during the circulation of the blood, was long maintained by physiologists. This doctrine, however, has of late been considerably modified: and, it is now believed, that, although the chemical cause operates, to a certain extent, much of the effect is dependant on the influence of the nerves, and the mysterious principle of life operating by them.

† Roget's Bridgewater Treatise, vol. ii. p. 345.

rials which consist almost wholly of water, with a small proportion of carbonic acid, and a few saline ingredients, of which that water is the vehicle. But these, after having been converted, by the powers of vegetable assimilation, into the substance of the plant, acquire the characteristic properties of organized products, though they are still the simplest of that class. In this state, and when the fabric they had composed is destroyed, and they are scattered over the soil, they are fitted to become more highly nutritive to other plants, which absorb them, and with more facility adapt them to the purposes of their own systems. Here they receive a still higher degree of elaboration; and thus the same materials may pass through several successive series of modifications, till they become the food of animals, and are then made to undergo still further changes. New elements (and, in particular, nitrogen) are added to the oxygen, hydrogen, and carbon, which are the chief constituents of vegetable substances; and new properties are acquired from the varied combinations into which their elements are made to enter, by the more energetic powers of assimilation appertaining to the animal system. The products which result are still more removed from their original state of inorganic matter; and, in this condition, they serve as the appropriate food of carnivorous animals, which generally hold a higher rank in the scale of organization, than those that subsist only on vegetables.

'Thus has each created being been formed, with reference not merely to its own welfare, but also to that of multitudes of others, which are dependant on it for their support, their preservation,—nay, even for their existence. In contemplating this mutual relationship, this successive subordination of the different races to one another, and this continual tendency to increased refinement, we cannot shut our eyes to the magnificent unfolding of the great scheme of Nature, for the progressive attainment of higher objects; until, in the perfect system and exalted endowments of man, we behold the last result which has been manifested to us of Creative Power.'*

* Roget's Bridgewater Treatise, vol. ii. pp. 13—15.

FOURTH WEEK—SUNDAY

'THE SAME LORD OVER ALL.'*

On this returning Sabbath, let us reflect upon the power of God as displayed in the works of his hands. In the words of Scripture, he is 'the same Lord over all.' He is the Creator, the Preserver, and the Governor of the Universe. Ere he summoned this earth into existence, He reigned on high in sovereign majesty. There is, and ever shall be, no rival near his throne; for he 'was, and is, and is to come,' the 'King eternal, immortal, and invisible,—the only living and true God, inhabiting eternity and its praises, whose name alone is holy,' and who is 'without variableness or shadow of turning.'

He sent forth his creative word, and this solid earth arose. His Spirit had brooded 'upon the face of the waters,' and the restless ocean heaved back its tumultuous surges from off the dry land. Then vegetation, in all its varied beauty, was spread abroad over the surface of our globe,—from the stately monarch of the woods, down to the humblest flower that decks the streamlet's side. And every thing in which is the breath of life, was ushered into existence; the beast that roams in the forest,—the bird that cleaves the vault of heaven,—the tiny insect that glitters in the sunbeam,—and the finny tribes that seek their way through the watery depths. And, lastly, man was formed,—his body from the dust of the ground,—his soul in the image of his holy Maker. All these, varied and wondrous though they be, owe their origin to the will of one Almighty and Eternal Spirit,—'the same Lord over all.' Unlike the works of man, the works of Nature are stamped with a character which speaks of the power, and the wisdom, and the goodness of a presiding Deity. The noblest specimens of human art, imperfect after the improvements of many generations, must yield to decay. The most ingenious mech

* Rom. x. 12.

anism which human skill can devise, formed as it is out of the materials afforded by nature, must fail, and perish beneath the hand of time. But it is not so with the works of God. Perfection is inscribed on every one of them. They endure until they have fulfilled the immediate purposes of their formation; and even when, to us, they may appear to be destroyed, they do, in reality, but alter their form and position, that they may take a part in other processes of nature, no less wonderful, and no less demonstrative of the power, and wisdom, and goodness, of the same unchangeable Creator. The tree loses its beauty, when the breath of autumn has stripped it of its foliage. Yet even then, it is only resting, as it were, that it may put forth its renewed energy in all the loveliness of opening spring. The blossom must wither and die; but it is only that it may give place to the more precious and more valued fruit. The fruit also must be shed, and must decay; but it is that the seed, being brought to maturity, may be buried in the earth. And there, while hidden from our sight, and where, but that experience teaches us otherwise, we might deem that it was lost for ever,—a living energy is at work, although we see it not, which will bid it come forth, to bud, and bloom, and flourish, in its appointed season.

This is but one proof, amidst a countless multitude, that it is the 'same Lord' who 'ruleth over all.' From the minute were we to turn to the vast, we should find the same truth inscribed on universal nature. Not only do the elements of earth harmonize with each other so as to exhibit one uniform design pervading the whole, and one infinite Mind fitting them to each other by measured and balanced laws,—but, if we cast our eye beyond the bounds of this little sphere, we shall find the very same simple but efficient powers and material properties regulating the most distant worlds, as well as those which belong to our own system. Their light is the same, their attracting forces are the same, their laws of motion are the same; the same mighty plan wheels them in circles round some common centre. While there is something exceedingly satisfactory to the human mind to know the uni-

versality of the powers impressed on nature, and the sameness or its arrangements, it assuredly elevates our conceptions of human ingenuity to be made aware that, by employing the endowments bestowed on him by his Maker, he has been able to demonstrate this truth.

We are, therefore, well warranted to conclude, that there is one Infinite Creator, and only one, who ruleth over all,—over all material agents, and over all immaterial agents, whatever these may be. How vast, then, must be the extent of his empire. From the earth to the sun; from the sun to the most distant visible star; and farther still,—far, far beyond the ken of mortals,—throughout space without bounds,—throughout duration without beginning and without end, He reigns. 'The heavens declare his glory, and the firmament showeth his handiwork.' While the celestial hosts move in beauty and brightness in the way He has prescribed, they proclaim 'their great original.'

And this eternal God rules over the children of men. He has opened to us a view of the world of spirits, and has assured us that we are under training for the society and functions of the higher beings, of whose existence He has made us aware. 'This mortal must put on immortality, and this corruptible incorruption.' He is Lord, also, of the spiritual world. Of old, He created the Heaven of heavens, where He reigns in unclouded majesty, surrounded by cherubim and seraphim, angels and archangels, the holy and happy spirits whom He has formed, that they may 'serve Him day and night continually.' Here is His more immediate presence. This is the region of taintless purity and of unfading loveliness; into whose blessed realms of life and light, death and sin can never enter; and from whose remotest borders sorrow and sighing are for ever excluded. It is this happy country which is the inheritance of the Redeemed; and into its highest glories they shall be ushered, when the last trumpet shall marshal their dead bodies, that they may exchange the darkness and corruption of the tomb for everlasting brightness and unwearying bliss.

He is Lord also, of the powers of darkness. Hell is the place of banishment which He has formed for the transgressors of his law, and rebels against his authority. There also He reigns; but it is in awful, wrathful, frowning majesty. With the inhabitants of this dread abode the ungodly among the children of Adam are destined to associate. 'Their worm dieth not, and their fire is not quenched.' The smoke of their torment ascendeth for ever. But in no instance is misery the rule of God's government; it is only the exception. 'How vast soever the kingdom of darkness may be, in itself considered,' says an eloquent divine, 'it is certainly nothing more than the prison of the universe, and small, indeed, compared to the realms of light and joy.* The misery of that unholy community, when the eye is fixed upon that only, fills the soul; but when from this dreadful exhibition of sin, and display of justice, we raise the adoring eye to God, reigning throughout his boundless dominions, and rejoicing in their joy, the world of misery shrinks to a point, and the wailings of the damned die away, and are lost in the song of praise.'† J. R. D.

FOURTH WEEK—MONDAY.

ANIMAL STRUCTURE.—THE GASTRIC JUICE—MUSCULAR POWER—NATURE OF THE PROOF OF CREATIVE WISDOM DERIVED FROM THE ANIMAL FRAME.

'When we speak of an organ as peculiarly suited to exhibit design,' says Sir Charles Bell, 'we mean merely that

* Let it be observed, that this determines nothing as to the relative numbers of the redeemed and lost, as regards this world. The benevolent character of the Creator is vindicated, if, in the whole connected system of the universe, happiness predominate.

† Sermon on the Government of God, by the Rev. Lyman Beecher, of East Hampton, Long Island

we comprehend something of the object of the particular structure:—But there is no part of an animal, if we fully comprehended what was necessary to the performance of its functions, that would not raise our admiration. Were we to take a portion of the skin, and contemplate its extreme sensibility, so finely apportioned,—could we penetrate, as it were, into the pores, and duly estimate the power, which regulates the secretions and absorption,—could we fully understand the relations of this organ, either with the economy of the body within, or the constitution of the atmosphere without,—we should have no occasion to draw our argument, for the twentieth time, from the structure of the eye or the ear. Were we to take one cell of the millions of that substance which, intervening between the more solid textures of the frame, gives elasticity to the whole, and permits circulation and muscular action, and all the various movements of the body, we should have, in that one cell, as much reason for wonder at the perfection of the contrivance, as in any joint of the limb.'*

These weighty observations come with peculiar force from an anatomist and physiologist of such well-earned celebrity, and show, at a single glance, the indefinite extent of the subject to which we are now slightly adverting. It leads us also to perceive why certain parts of the organized frame are more clearly discerned to be skilfully contrived than other parts. It is because the former more strictly correspond with a mechanism, or with processes of which we have examples in the arts, or with which science has made us otherwise acquainted. Our imperfect knowledge allows us frequently only a glimpse into a world of wonders. And this is the case with the contrivances which formed the subject of Saturday's paper. We see enough, however, even in that superficial sketch, to convince us, that were we to penetrate deeper, the Divine perfections would be exhibited more and

* Note to Paley's Natural Theology Knight's edition, 1836. Pp. 99–101.

more clearly, just in proportion to the enlargement of our powers of perception.

Dr. Paley has given a very striking instance of the kind of ignorance to which I allude, and draws the precise limit to which the nature and extent of our knowledge confines us. 'There is,' says he, 'what may be called the chemical part of our frame, of which, by reason of the imperfection of our chemistry, we can attain to no distinct knowledge; I mean, not to a knowledge, either in degree or kind, similar to that which we possess of the mechanical part of our frame. It does not, therefore, afford the same species of argument as that which mechanism affords; and yet it may afford an argument in a high degree satisfactory. The gastric juice, or the liquor which digests the food in the stomach of animals, is of this class. Of all the *menstrua* it is the most active, the most universal. In the human stomach, for instance, consider what a variety of strange substances, and how widely different from one another, it in a few hours reduces to a uniform pulp, milk, or mucilage. It seizes upon every thing, it dissolves the texture of almost every thing that comes in its way. The flesh of perhaps all animals; the seeds and fruits of the greatest number of plants; the roots, and stalks, and leaves of many, hard and tough as they are, yield to its powerful pervasion. The change wrought by it is different from any chemical solution which we can produce, or with which we are acquainted, in this respect, as well as in many others, that, in our chemistry, particular menstrua act only upon particular substances. Consider, moreover, that this fluid, stronger in its operation than a caustic alkali, or mineral acid,—than red precipitate, or aquafortis itself,—is nevertheless as mild, and bland, and inoffensive to the touch or taste, as saliva, or gum-water, which it much resembles. Consider, I say, these several properties of the digestive organ, and of the juice with which it is supplied, or rather with which it is made to supply itself, and you will confess it to be entitled to a name which it has

sometimes received, that of *the chemical wonder of animal nature.**

Now, although we are ignorant of the composition of this fluid, and of the mode of its action, this ought not to hinder us, as our author justly argues, from acquiescing in the inference, which a production of nature, by its place, its properties, its action, its surprising efficacy, its invaluable use, authorizes us to draw in respect of Creative Design.

This kind of observation may be very extensively employed, as it is applicable, not merely to the chemical, but to the mechanical parts of the animal frame. We perceive the mechanical law, and know that, when operated upon in a particular way, certain effects must occur, which effects we see actually produced; but then we are altogether ignorant of the mode by which the organ in question is brought into operation. An example of this we find in the construction of a muscle. The peculiar property which characterizes the muscular fibre is that of suddenly shortening itself, so as to bring its two ends, and the parts to which these ends are attached, nearer to each other. This contraction is performed with astonishing quickness and force, and the accumulated effect of a large collection of these fibres, such as constitutes a muscle, is therefore capable of overcoming great resistances, or of raising enormous weights. There is nothing like this power in the vegetable kingdom; but it is the primary moving force of the animal machine, applied in a great variety of ways, and adjusted by the most refined application of the laws of mechanism, to all the degrees and kinds of effects intended to be produced. 'Everywhere,' observes Dr. Roget, 'do we find the wisest adaptation of muscular power to the objects proposed, whether it be exerted in laborious efforts of the limb and trunk; whether employed in balancing the frame, or urging it into quick progression; or whether it be applied to direct the delicate evolutions of the fingers, the rapid movements of the organs of speech, or the more exquisite adjustments of the eye or of the internal ear. Amidst

* Paley's Natural Theology, vol. i. Knight's Edition, pp. 105, 106.

the endless combinations of machinery exhibited in different parts of the animal kingdom, although the mode of application be diversified in ten thousand ways, the original power is still of the same kind, and is regulated by the same physical laws; and similar instruments are employed in effecting this infinite variety of purposes, by the all-wise and omnipotent Architect of Animated Creation.'* The mechanical power here applied is the swelling of the belly of the muscle, and the consequent contraction of its tendons. This is easily understood; but what is totally unknown, and will probably continue to be unknown, is the substance or power, whatever it may be, which causes this swelling, whether voluntary or involuntary. It is different from any thing we are acquainted with, and we are unable to construct a machine, by any power of mechanism, which shall be endowed with the same principle. That principle, in short, is not mechanical, though it operates on a very refined piece of mechanism; and we can follow it no farther. But there is no reason arising from our ignorance of this unmechanical principle, which ought to throw any doubt upon the nature of the organization itself, or weaken the proof of intelligent contrivance which it affords. With the very same certainty as if we knew the origin of the motion, we can trace the artificial construction of the muscle for producing the necessary contraction, its skilful position for effecting a particular purpose, and the various combinations and adaptations of such instruments, so wonderfully uniting in a living body to form a perfect whole; and from all this we can derive a proof of design, which no sophistry can gainsay.

From such a mode of reasoning, we may discover both the advantages and disadvantages under which the physiologist labours, when he adduces the animal frame as a proof of Creative Wisdom; and Paley, after illustrating the subject much more at large, and arguing with his usual precision, comes justly to the following conclusions; first, that it is a mistake to suppose, that, in reasoning from the appearances

* Roget's Bridgewater Treatise, vol. i. p. 141.

of nature, the imperfection of our knowledge proportionally affects the certainty of our conclusion, for in many cases it does not affect it at all; secondly, that the different parts of the animal frame may be classed and distributed according to the degree of exactness with which we compare them with works of art; thirdly, that the *mechanical* parts of our frame, or those in which this comparison is most complete, and although constituting, probably, the coarsest portions of nature's workmanship, are the most proper to be alleged as proofs and specimens of design.*

FOURTH WEEK—TUESDAY.

REPRODUCTION AMONG THE LOWER ORDERS OF ANIMALS.

Spring is peculiarly the season of reproduction; and the diversified means by which the various species of animals as well as plants are thus preserved, furnish one of the appropriate subjects of the season, and perhaps the most interesting of all. The same character of similarity in the plan, and difference in the details, which belongs to the rest of the Creator's works, appears strikingly in this. A difference of sexes, which we have seen as one of the features in the reproduction of plants, is exhibited with not less uniformity in all the higher species of animated beings; in which last, however, this difference exists constantly in *distinct* individuals, and never, as frequently takes place among vegetables, in the same individual. But among the lowest orders of the animated creation, this uniformity seems to be departed from, and we have instances of reproduction altogether peculiar and anomalous. According to our plan of beginning at the lowest links of the scale, these shall form the subject of consideration in the present paper.

Fissiparous generation, as it is called, that is, the spontaneous division of the parent into two or more parts, is the

* Natural Theology, Knight's edition, p. 114.

simplest of all the modes of reproduction. Of such a mode, frequent instances occur among infusory animalcules. Many species of globular monads multiply in this way. At a certain period of their development, a slight circular depression appears round the centre of these living balls, which, by degrees, becomes deeper, changing their form to the resemblance of an hour-glass, till at last two globes are formed out of one, attached, like the Siamese Twins, by a single point. These twin existences are now seen swimming irregularly in the fluid which they inhabit, as if animated by two different wills. They struggle to get disunited, and for this purpose laboriously drag each other, first one way and then another, or, by a simultaneous movement, dart through the thickest crowd of the surrounding animalcules. The moment this slender filament is broken, they are observed moving away, without apparent recognition, and each beginning its own independent existence.

These globular animalcules are exceedingly small; and as the infusory tribes increase in size, they take a different shape, many of them being comparatively thick at one end, and tapering to a point at the other, somewhat in the form of a tad-pole. Such of these, as follow the same law of reproduction with the monads we have mentioned, separate from each other lengthwise, forming the division by an incision beginning at the thicker end, and gradually becoming larger and larger, till, after a struggle similar to that of their globular congeners, they finally disunite at the hair-like extremity of the tail. Each animalcule thus formed, soon grows to the size which again determines a further spontaneous subdivision; and thus the same process goes on to an indefinite extent.

'The most singular circumstance attending this mode of multiplication is, that it is impossible to pronounce which of the two new individuals, thus formed out of a single one, should be regarded as the parent, and which as the offspring, for they are both of equal size. Unless, therefore, we consider the separation of the parts of the parent animal to constitute the close of its individual existence, we must recognize

an unbroken continuity in the vitality of the animal, thus transmitted from the original stem, throughout all succeeding generations. This, however, is one of these metaphysical subtleties, for which the subject of reproduction affords abundant scope.'*

In the vegetable kingdom we have no instance of this kind of spontaneous division of an organized being into complete separate existences; but, by artificial means, this mode of reproduction may be effected. Thus, a tree may be divided horizontally into slips, which may continue to grow, and may by-and-by produce a tree similar in all respects to that from which it originated. Even from a small fragment of a plant, under favourable circumstances, a complete plant may be formed, by roots shooting out from the one end, and a stem from the other. These facts show a peculiar species of reproductive power in the vegetable creation under the culture of man, but do not occur in the ordinary course of things.

Of this latter mode of multiplication, we have numerous examples in the lower departments of the animal kingdom. The *Hydra*, or fresh-water polype, is capable of indefinite multiplication by division, although this is not the natural mode of its reproduction. If it be cut asunder transversely, the part containing the head soon supplies itself with a tail, and the detached tail shoots forth a new head, with a new set of tentacula; and if the whole animal be divided into a great number of pieces, each separate fragment acquires, in a short time, all the parts which are wanting to render it an entire individual. The same phenomena are observed, and nearly to the same extent, in the *Plantaria*. The *Asteria*, the *Actinia*, and some of the lower species of *Annelida*, are also capable of being multiplied by artificial divisions—each segment having the power of producing others, and containing within itself a kind of separate vitality.

Something analogous to this, but by no means extending to the capability of reproducing a complete being, exists, in a certain degree, among the higher orders of animals, especial-

* Roget's Bridgewater Treatise, vol. ii. pp. 583—585.

ly in the lower links of the chain. The claws, the feet, the antennæ, and the entire limbs of some of the inferior species of these orders, are restored, when lost, by a fresh growth of the organs. The crab renews its limbs when torn off. If the head of a snail be amputated, the whole of that part of the animal, including its eyes and other organs of sense, will be reproduced. The tails of newts, and of some species of lizards, will grow again, if lost; and even the eyes of these animals, with all their complex apparatus of coats and humours, will, if removed, be replaced by the growth of new eyes. Among the highest class of all, too, similar powers exist, though much restricted. The principle which, in the human frame, closes a wound, repairs a broken bone, or alters the course of the blood when the ordinary channels are closed, is of the same nature, and forms a most beneficent provision.

The less perfect orders of that low class of animated nature called *Zoophytes*, produce the species in a manner analogous to the buds of plants. At the earliest period in which the young of the *Hydra*, for example, is visible, it appears like a small tubercle or bud rising from the surface of the parent. It grows in this situation, and remains attached for a considerable time, at first deriving its nourishment from the parent; then occasionally stretching forth its *tentacula*, and learning the art of catching and swallowing its natural prey. At length the tube through which it received parental nourishment closes, the attaching filaments become more slender and break, and the young hydra moves away, and provides for its own subsistence.*

Another plan of reproduction is that in which the germs are developed in the interior of the animal, assuming, in the first stages of animation, the form of the parent. In the *Volvox*, a spherical revolving animalcule, of the infusory order, this mode is exemplified. The germs of this animal appear,

* There is a species of toad which is said to produce its young nearly in a similar manner, or, at least, similar in appearance. The impregnated germs are conveyed by some occult process to the back, where they grow below the skin like buds, till the period of birth, when they burst forth.

by the aid of the microscope, in great numbers, in its interior, through its transparent covering; and while these are yet retained within the parent's body, other still minuter globules are developed within them, constituting a third generation. This progeny continues to swell till the parent bursts, and thus, in expiring, opens a passage for them to the elemen where they are in their turn to undergo the same destiny.* In the case of the *Actinia*, the young, or *gemmules*, as such productions are called, force their way through the sides of the body, which readily open to give them passage, and quickly heal; but in most instances of such kind of spontaneous evolution, channels are provided, through which they find their way to a separate existence.

These are some of the extraordinary modes by which the species is continued while the individual perishes, affording us a new and striking proof, that, though the analogies of nature are preserved with remarkable regularity in all the higher species of existences, it is not because the Creator fails in resources and expedients, but because some wise plan of his government has induced him to restrict his creative power, as regards these classes, to certain forms and types, while, in the less complicated organizations, he has found it expedient to take greater latitude. Nothing can be more curious and instructive than the view which the microscope has opened to us, of that busy world of living beings, which lies beyond the sphere of our unassisted vision, so incalculable in their numbers, so diversified in their forms, so opposite from our experience in their modes of propagation, and their means of subsistence; and yet so wonderfully harmonizing, amidst all their vast and anomalous varieties, with the more general analogies with which our senses have made us conversant, as to indicate most unequivocally the contriving mind and plastic hand of One Infinite Intelligence.

* Roget's Bridgewater Treatise, vol. ii. p. 586.

FOURTH WEEK—WEDNESDAY.

REPRODUCTION AMONG THE HIGHER ORDERS OF ANIMALS.

In ascending from the lower and less complicated forms of animal existence to higher orders, we find the mode of reproduction more uniform, or at least more strictly confined to a single type, though still various and peculiar, in different species, with regard to matters of subordinate detail. In all the more perfect animals, reproduction takes place by means of a seed, or ovum, which is a process essentially different in its nature, as well as in the mode of operation, from those already described. In the animal as well as vegetable world, the germ, latent in the seed, is never developed beyond a certain point, unless it be vivified by the action of a peculiar fluid belonging to other organs. The germ, when thus impregnated, receives the name of *embryo*, and the development takes place in one or other of the four following ways:—

1*st*, The ovum, when defended by a firm envelope, which contains a store of nutriment, is termed an *egg*, and is deposited in situations most favourable for the development of the embryo, and also for its future support, when it emerges from the egg. Birds, as is well known, produce eggs which are encased in a calcareous shell, and hatch them by the warmth they communicate, in sitting on them with unwearied constancy. All animals which thus lay eggs are termed *oviparous.*

2*d*, There are a few tribes, such as the *viper* and the *salamander*, whose eggs are never laid, but are hatched in the interior of the parent, so that they bring forth living offspring, although originally contained in eggs. Such animals are said to be *ovo-viviparous.* There are other tribes, again, which, according to circumstances, are either oviparous, or ovo-viviparous. This is the case with the *shark.*

3*d*, *Viviparous* animals, are those in which no egg, properly so called, is completed; but the ovum, after passing through

the oviduct, sends out vessels which form an attachment to the interior of a cavity in the body of the parent, whence it draws nourishment, and therefore has attained a considerable size at the time of its birth.

4*th*, *Marsupial* animals, are those which, like the *kangaroo* and the *opossum*, are provided with abdominal pouches, into which the young, born at a very early age of development, are received, and where they are nourished with milk secreted from glands contained within these pouches. As the young, both in this and the last case, are nourished with milk prepared by similar glands, or *mammæ*, the whole class of viviparous and marsupial animals has received, from this characteristic circumstance, the name of *Mammalia*, that is, animals with *teats*, or milk-vessels.*

The varieties, now mentioned, in the means by which the first processes of reproduction are effected, are neither accidental nor capricious. They are adaptations of remarkable wisdom, connected always with peculiar conditions, either in the state or structure of the organized beings in which they occur. They are parts of a system, which is perfect in its various functions and relations, and admirably suited to fulfil the object in view. We may not always be able to trace the peculiar bearings of this system in all its branches; but, in general, it is open, at least in its great features, to human research; and, even where it is more recondite, there are still circumstances of obvious adjustment, which enable us confidently to say, that here are indications of admirable contrivance and forethought. The simple mode of reproduction, for example, by partition or fissiparous generation, as it is called, or even by buds or germs, produced externally or internally, though well adapted to animals of the infusory tribes, would obviously interfere most essentially with the active functions necessary for the preservation, defence, or enjoyment of animals of a higher grade, and inhabiting another element. We have only to conceive a bird, a quadruped, or a human being, constantly, or even occasionally, undergoing either of the re-

* Roget's Bridgewater Treatise, vol. ii. pp 597, 598.

markable processes by which a monad or a zoophyte multiplies its species, to perceive how unsuitable such a mode would be to their condition; and the more we compare the actual means employed, with the relative situation and circumstances of the different orders, the more reason shall we find to adore the perfections of the Creator. In this general statement, every person, even on the slightest consideration, must find cause to acquiesce; and the more we enter into detail, our admiration will be proportionably increased. It is but a small portion, however, after all, that we can perceive of Creative Intelligence; because our ignorance continually interferes with the researches we make in any direction. All is full of wise adaptation and contrivance, so far as we can trace, and every new discovery of the properties and relations of things, affords us a farther insight into the beautiful designs of an all-pervading Mind; while the farther we penetrate, our convictions become the stronger, that we are yet but at the surface, and that what remains behind, could we but dive still deeper, would only furnish us with more irrefragable evidence of the attributes we love and venerate, in what we actually behold. In prosecuting this pleasing subject, such a view has constantly forced itself on my mind, and I have felt, that, while the operations I described have displayed much of the Divine power, and wisdom, and goodness, I was, after all, only taking an ignorant and superficial survey of a subject of infinite extent,—only looking at the elegant external proportions, and the outward grace of a building, which within was full of a fitness and a grandeur, that, in this mortal state, with my limited faculties and imperfect knowledge, I was not permitted either to approach or to conceive. How delightful is the assurance, that the time will come when, if we belong to that blessed company who inherit the promises of the Gospel, we shall no longer see as 'through a glass darkly.' When that which is perfect is come, and we see 'face to face,' the further discoveries which our enlarged faculties shall be permitted to make, will, as we may well believe, form no mean part of the happiness which Heaven has in store for us.

FOURTH WEEK—THURSDAY.

INSTINCTS CONNECTED WITH THE REPRODUCTION OF ANIMALS.

However curious and instructive the subject of reproduction may be, in relation to its physiological laws and conditions, it is certainly not less so as regards the instinctive propensities and habits, by which these are brought into operation and rendered effectual for the accomplishment of the great object the Creator had obviously in view; and there are few things more wonderful, or more strikingly indicative of wise and harmonious design, than the adaptation of the animal instincts to the physical circumstances of the parent, the embryo, and the offspring. Were there not an exact and intimate correspondence between those two distinct and totally dissimilar things,—the material organization and the living propensity,—reproduction would be impeded not only at every step of its progress, but at its very source, so that the continued existence of any one species of animals would be impossible. To enter into details as to some of these adaptations, would be as inexpedient as it is unnecessary; but the fact, that immediately after the wintry blast which desolated Nature has ceased, and as soon as Spring has begun to scatter a profusion of food over the face of the earth, and to cheer and nourish all things with her balmy breath, the lower animals should choose their mates, and those remarkable instincts should commence their influence, which are to repair the waste occasioned by the law of universal decay, and constantly to replenish the world with living beings, is, in all its circumstances, a phenomenon which, on the most superficial glance, clearly indicates the plan of an Intelligent Creator.

When from this general view we turn to the operation of these instincts in the various races of the animated world, we find with admiration and delight the same uniformity mingled with diversity, which distinguishes the operations of the Creator in other departments of his works, the same adjust-

ment of causes to ends, of instincts to forms, of propensities to propensities, and of one condition to all the rest.

I shall at present take a rapid view of these reproductive instincts, as they appear in the various tribes of animals, with the intention of afterwards filling up the sketch by such details as may serve more fully to illustrate the Divine perfections, exhibited in the means made use of for the preservation of animal life through successive generations.

To begin with the *insect* world; these have all their seasons for fulfilling the great law of Nature, varying according to their peculiar functions and destinies, numerous as these are, to which the organization of each is most admirably adapted, and with which their reproductive propensities are in beautiful unison. It is exceedingly remarkable, as we shall presently see, to observe how each is directed to deposit its eggs where its young, when disclosed, may find their appropriate nutriment. Various circumstances seem to point to the scent,* as the sense by which they are directed to the proper station for their eggs. But whatever there may be in this, the inward propensity is not the less admirable, which conducts by far the most numerous classes of insects, and more especially the whole tribes of the *Lepidoptera*, to seek for a place of deposit for their precious charge, where their larvæ, when developed, may find a species of food suitable for the offspring, but never once used by the parents.

Of vertebrated animals, the lowest classes are cold-blooded, including reptiles and fishes. These seem to have little of that instinctive attention to the welfare of their offspring, which belongs to many of the insect tribes, and is not less remarkably exhibited by numerous families of the warm-blooded animals. They, however, are invariably instructed by the Creator to select a proper situation for their eggs or spawn, where they may be hatched either by artificial heat, or that of the sun. Snakes and other *Ophidians* bury their eggs in sand,

* The flesh-fly, for example, deceived by the smell, frequently lays her eggs on the carrion plant, mistaking it for a piece of decaying flesh, which it greatly resembles in its disagreeable odour.

and not seldom even in heaps of fermenting manure, while the venomous species of serpents are hatched in the womb of the dam. The lizard tribes, from the crocodile downwards, lay their eggs in some well-selected spot, and then leave them to the fostering power of the elements; toads and frogs lay their spawn in the water;—the former, producing two long strings, resembling necklaces, formed, as it were, of beads of jet, enclosed in crystal; while those of the latter consist of irregular masses of similar beads. This gelatinous envelope forms the first nutriment of the embryo. 'The nuptial song of reptiles,' adds Kirby, after giving similar details, 'is not, like that of birds, the delight of every heart; but is rather calculated to disturb and horrify than to still the soul. The hiss of serpents, the croaking of frogs and toads, the moaning of turtles, the bellowing of crocodiles and alligators, form their gamot of discords.'* Here, also, we may read beneficent Design. Birds are the companions of man in the lawn and forest, in his solitary walks, amidst his rural labours, and around the home of his domestic enjoyments. They are, therefore, framed beautiful to the eye, and pleasing to the ear; but of the reptile tribes, some are his formidable enemies, and none were ever intended to be his associates. They shun cultivation, and inhabit unfrequented marshes or gloomy wilds. Their harsh notes, and ungainly or disgusting forms, serve, therefore, to warn him of danger, or to turn his steps to places more fit for his habitation.

With regard to the class of *fishes*, the general object of those that migrate, appears to be the casting of their spawn. It is this that causes the salmon to leave the sea for the rivers; the herring to travel from the profound depths of the north to

* Kirby's Bridgewater Treatise, vol. ii. p. 205. In the first volume, the same author says, 'Travellers describe the noises of crocodiles and alligators as horrible.' 'Crocodiles, during the whole summer,' says Bosc, 'but especially after they emerge from the earth, that is, in the spring, and the epoch of their amours, frequently send forth lowings almost as loud as those of an ox. They respond to each other often by hundreds, especially in the evening, which makes in the swampy forest, a frightful and thundering din.'

our native shores; and the mackerel, on the other hand, to pour from the southern regions towards the north; thus, at the same time, by the fiat of their Maker, contributing to their own means of subsistence, and placing themselves in situations where their fellow inhabitants of the ocean may combine with man in preserving the balance of living beings, by thinning their numbers, which their productive powers would otherwise render overwhelming.

If we rise higher in the scale of vertebrated animals, and direct our attention to birds, what a variety of wonderful instincts and habits relating to the propagation of the species meets our view. Some of them, chiefly influenced by this instinct, take long aerial voyages, steering their course over sea and land with a mysterious precision, and arriving, year by year, after traversing vast spaces and crossing many latitudes, at the very same spot where they commenced their own existence, or gave birth to a former progeny; there they rebuild their decayed nests, deposit and hatch their eggs, tend and nourish their callow brood, teach them to use their wings and select their food, and then, when their young powers are fully developed, lead their course through the air, to those distant lands where new and more ample stores are provided for their subsistence by an All-bountiful Hand. Others, though they seek not to migrate, yet display the wonders of that mysterious Power by which they are guided, in the forethought, not their own, by which they are directed with regard to the structure and situation of their nests. One builds upon the surface of the earth; another under ground or in the sand; some select the chimneys or eaves of houses for the place of their structures; some retire to caverns and holes; but the great majority erect their temporary dwelling-places in trees and bushes, with singular arts to elude the pursuits of their enemies.

With regard to quadrupeds, as they escape the long process of incubation, which reproduction by means of eggs imposes on birds, and as their young seldom come into the world helpless, or altogether without the power of locomotion, their pre-

paratory actions are less striking, but are yet most carefully adapted to their circumstances. The dormouse, and various other animals of the same genus, make beds of their own hair, to prepare soft and warm retreats for their young, at the bottom of their holes, to which these, and the other burrowing animals retire, when nature informs them that their hour of travail is come. The domesticated animals, in general, drop their young without any previous preparation,* wherever the pains of labour overtake them; because they procure their own food without care, and in their bodies is contained a delicious and nourishing fluid, which instinct has at once taught them how to offer, and their new dropped offspring how to extract. Beasts of prey, on the other hand, whose progeny come into the world blind, as well as the domestic dog and cat, perform parental duties varied and important, in proportion to the dependence of their offspring on their care. They retire to their dens or lairs, where they tenderly watch over their helpless charge, and, if danger approach, or convenience require, carry them from place to place in their mouths.

All these are instances of an instinct singularly adapted to the situation and wants of the various tribes which are the objects of it; and both in the complication and the simplicity of its movements, evinces a contriving Mind of never-failing resources. The *Storge*, as the ancients were accustomed to name it, or the natural affection of the parent to its offspring, involved in some of these actions, deserves to be considered in a separate paper.

* Lord Kaimes, however, in his 'Gentleman Farmer,' mentions the singular fact, that the female sheep, weeks before yeaning, selects some sheltered spot where she may drop her lamb with most comfort and security; and that, when forcibly prevented from going there, she manifests the utmost uneasiness.

FOURTH WEEK—FRIDAY

PARENTAL AFFECTION.

In former papers, the attention of the reader has been di rected to the wonderful provision, which is made for the preservation of the species of many living beings, which never see their progeny. We have seen, however, that there is another class—and it is a very numerous one—comprehending all the higher orders of animals, the young of which are, for a longer or shorter period, dependant on the fostering care of their elder kindred, which are generally their parents. And in this, as in the former case, the wisdom and benevolence of the Creator are very strikingly displayed; for He providentially inspires the guardians with so strong a desire to discharge their trust with fidelity, that it may well be denominated a passion.

There is, perhaps, no living creature that enters this world in a condition more helpless than man; nor is there any which so tardily attains maturity, in its physical and mental powers. Were the weak and naked infant to be abandoned at its birth, its first breath would soon be succeeded by its last. But it has been ordained that the cries which it emits shall awake in the bosom of the mother, a throe of tender affection, which constrains her irresistibly to devote herself to its nourishment, its protection, and its comfort. In the continued practice of her maternal duties, she experiences a growing and inexpressible delight; and it is mercifully arranged by the Ruler of all, that her affection shall, in general, become more intense, in proportion to the necessity which exists for its exercise. The cripple, the invalid, and the imbecile, are the objects of her peculiar tenderness. That she may minister to their relief and their happiness, she generously abridges her personal indulgences, and her natural portion of rest.

The father participates, to a great degree, in the parental tenderness of his wife; and, if not utterly debased by corrup-

tion, while he fondles and plays with his little ones, his manly heart is softened and improved.

As the young family increases and grows up, its members, if abandoned at so early a stage of their existence, without protection and tuition, would be exposed to inevitable destruction. But their parents are impelled still to watch over them, and, according to their own progress in civilization, to labour with redoubled diligence for their support. If they know what is good, they train them to those arts, and instil in their minds those principles, and that knowledge which may qualify them to gain their living as they approach maturity, to act their part usefully in society, and to enjoy a happy eternity.

The yearnings of parental love are experienced in every stage of civilization. Superstition and wickedness have, no doubt, produced partial exceptions; but these are, by the common voice of humanity, pronounced unnatural; and the parent, when influenced by the unbiassed emotions of his heart, shrinks back with horror at the thought of committing the fruit of his body to the flames or the waves, even for the purpose of appeasing an offended Deity. Nor can any parent hear, without disgust, of famishing women allaying the pangs of hunger with the flesh of their own offspring.*

Too true it is that there are innumerable instances in which ignorant and depraved men train their children to ruin, by example and by precept; yet even these infatuated wretches are rarely devoid of all instinctive partiality for them. Even when occasional anomalies occur, and when the 'father and mother forsake' their offspring, 'then the Lord will take them up,' and supply them with guardians, to fulfil the parental duties. The same providential care is exerted by opening an affectionate interest in the hearts of near relatives, and even of aliens in blood, when the young and helpless are bereft of their natural guardians by death, or by some painful casualty. And it is worthy of remark, that, in such interesting cases, the affection of the substitutes, also, is proportioned to the ne-

* Lamentations iv. 10.

cessities of their dependants. Even a hireling very soon acquires, for the infant she suckles, a love which may be called maternal. The writer of this could specify more than one instance in which nurses have requested liberty to retain and rear, at their own expense, the children of aliens committed to their charge by the parochial authorities.

Nor is the influence of this law confined to the human race. It extends to all species of animals, not excepting insects, which enter into the world in a state that finds them incapable of catering for their own support. Even the ferocious tiger, and the ravenous vulture, unequivocally manifest the yearnings of strong affection for their young. The mother always, and, in the case of pairing animals, the father frequently, furnish the food, and warmth, and protection, which are required, with the most disinterested sacrifices of personal rest and comfort. Reference has, in the preceding paper, been made to some creatures, which denude themselves of their natural clothing, to secure their offspring from cold, during the more helpless stage of their existence; and the anxiety with which they minister to the wants of their dependants, must excite the admiration of the most casual observer. To take a very familiar instance: Look at that domestic hen, with her little brood of chickens, and see how vigilantly she watches over them, searching out the food convenient for them, where it lies hidden under the rubbish, and, with generous self-denial, restraining her own appetite, that she may relieve their craving wants. See how she bristles up at the approach of a suspected stranger, and what a bold demonstration she makes of courage, which is foreign to her nature when she has no family to defend. Observe how anxiously she recalls her chickens when they heedlessly stray into paths of danger, and with what kind complacency she hides them amongst her feathers. She thus communicates to them, from her own body, that warmth which, in their unfledged state, is necessary for their comfort and vitality.*

* The writer remembers having once watched, with much interest, the proceedings of a barn-door hen, which, in the exercise of her maternal af-

None need be reminded of the occasion on which our Divine Redeemer referred to this affectionate habit of the domestic fowl, in illustration of his tender and disinterested love to the inhabitants of a murderous and ungrateful city.

The most timid mothers brave dangers, and even death, for the sake of their young. An instance of this courage—and similar facts must be familiar to many—is recorded by Colonel Montagu, when speaking of the gold-crested wren. 'A pair of these birds, who took possession of a fir-tree in my garden, ceased their notes as soon as the young were hatched; and as this beautiful little family caused me much delight and amusement, some observations thereon may not be unacceptable to the curious reader. When first I discovered the nest, I thought it a favourable opportunity to become acquainted with some of the manners of this minute species, and to endeavour to discover whether the male ever sung, by way of instructing the young ones. Accordingly I took the nest, when the young were about six days old, placed it in a small basket, and, by degrees, enticed the old ones to my study window; and after they became familiar with that situation, the basket was placed within the window, then at the opposite side of the room. It is remarkable that, although the female seemed regardless of danger, from her affection to her young, the male never once ventured within the room;

fection, laboured long, but ineffectually, to convey her brood across a shallow stream, on the opposite border of which she had discovered a treasure for their use. The timid chickens durst not enter the water; but, at last, the mother contrived to make them mount upon her back, and so to carry them over. This is an additional illustration of some remarks made in the first volume of this work. *Winter*, Fourth Edition, pp. 187, 235. To the same class of facts may be referred the following, which occurred many years ago at a farm-house in Galloway. The family were one evening alarmed by loud screams, accompanied by the flapping of wings, and, it is added, a knocking at the door, when, on going to ascertain the cause, a gander was discovered in a state of the utmost agitation. The creature led the way to the goose-house, evidently inviting the servants to follow. On entering, a polecat rushed out, and on a nest, with young goslings below her, lay a slaughtered goose, which had evidently refused to seek her own safety by sacrificing her young.

and yet would constantly feed them while they remained at the outside of the window; on the contrary, the female would feed them at the table at which I sat, and even when I held the nest in my hand, provided I remained motionless. But on moving my head one day while she was on the edge of the nest, which I held in my hand, she made a precipitate retreat, mistook the open part of the window, knocked herself against the glass, and lay breathless on the floor for some time. It it probable the focal distance of such minute animals' eyes is very near, and that large objects are not represented perfect on the *retina;* that they do not seem to see such distinctly is certain, unless in motion. However, recovering a little, she made her escape, and in about an hour after, I was agreeably surprised by her return; and she would afterwards frequently feed the young, while I held the nest in my hand. The male bird constantly attended the female in her flight to and fro, but never ventured beyond the window-frame; nor did he latterly ever appear with food in his bill.'

Even the earwig and the spider, which some regard as odious creatures, are inspired by the great Governor of all with this amiable disposition in a remarkable degree. The wolf-spider carries her eggs in a bag attached to the hinder part of her body, and guards this treasure with jealous care. With a view,' says Bonnet, 'to put this singular attachment to a novel test, I one day threw a spider with her eggs into the pit-fall of an ant-lion (*Myrmelion formicarium*). The spider endeavoured to escape, and was eagerly remounting the side of the pit, when I again tumbled her to the bottom, and the ant-lion, more nimble than the first time, seized the bag of eggs with its mandibles, and attempted to drag it under the sand. The spider, on the other hand, made the most strenuous efforts to keep her hold, and struggled hard to defeat the aim of the concealed depredator; but the gum which fastened her bag, not being calculated to withstand such violence, at length gave way, and the ant-lion was about to carry off the prize in triumph. The spider, however, instantly re

gained it with her mandibles, and redoubled her endeavours to snatch the bag from her enemy; but her efforts were vain, for the ant-lion being the stronger, succeeded in dragging it under the sand. The unfortunate mother, now robbed of her eggs, might at least have saved her own life, as she could easily have escaped out of the pit-fall; but, wonderful to tell, she chose rather to be buried alive along with her eggs. As the sand concealed from my view what was passing below, I laid hold of the spider, leaving the bag in the power of the ant-lion. But the affectionate mother, deprived of her bag, would not quit the spot where she had lost them, though I repeatedly pushed her with a twig. Life itself seemed to have become a burden to her, since all her hopes and pleasures were gone for ever.'*

Even among the inferior animals, the substitution of nurses different from the parents sometimes occurs; and, in such cases, the law continues in force, which elicts, in the guardian, a love for the proteges, akin to parental affection. This is well exemplified in the attendance which the foster-mother of the cuckoo so assiduously bestows on her overgrown charge, and may be seen in every farm-yard, where ducklings have been hatched under a hen, or chickens under a capon.† The unwearied care with which the larvæ of bees, wasps, and ants, are tended by barren nurses, has called forth the admiration of all who have minutely observed the domestic economy of these curious insects. Man may well learn wisdom by considering the ways of creatures which are destitute of reason; for they are guided by a wisdom infinitely

* Bonnet, Ouvres, vol. ii. p. 435.

† The writer can vouch for the following fact:—A barn-door fowl having been deprived, by some accident, of all her brood but one, resigned the survivor to the care of the cock, while she reconstructed her nest, and resumed the occupation of replenishing it with eggs. The cock entered into this arrangement with the utmost cordiality, and discharged his duties as a father with much zeal and love, courageously repelling every enemy, searching out barley-corns with the utmost diligence, giving the usual notice to his little follower, and feeding it with the characteristic generosity of his fraternity.

superior to his. They are irresistibly impelled, by an invisible power, to adopt means for promoting the best interests of their young. Man, too, is inclined by the same power to love his children; but he has sinful propensities within, which often lead that love into a ruinous direction.

'Let us hear the conclusion of the whole matter.' God is the *Parent of all;* and he uses natural affection to make his substitutes,—earthly parents of various species,—faithful to their trust. 'They are but the wheels and instruments,' says Burmeister, 'in a higher Hand, imperceptible to us and still more so to them, which holds the universe, and to which science must always refer, but which is depicted to the fancy in a beautiful and attractive image. What Johan Von Muller has expressed to be the result of his researches into the history of the human race, we may apply to the life of bees, to the actions of the rest of the world of insects, and indeed to the great efforts of organic nature in general. The whole is an infinite machine, to whose eternal motion every individual, be it plant, animal, or man, must contribute; and he who of all that can obey this law, is wantonly deaf,—he is judged.'* T. T. D.

FOURTH WEEK—SATURDAY.

REPRODUCTION OF INSECTS.—THEIR EGGS.

I HAVE already taken some notice of the eggs of insects, in reference to the qualities with which they are endowed for resisting the rigours of winter.† It may now be proper to say a few words regarding their general properties and peculiarities, as well as the instincts belonging to the female, which secure their deposition in the most proper situations.

It has been remarked by some naturalists, that the eggs of

* Manual of Entomology, p. 531.

† 'Winter,' Fourth Edition, p. 191, &c.

insects, which are of very various shapes and colours, have, at least in many instances, expansible shells, which enable them to increase in size, according to the progressive development of the enclosed larva. The younger Huber discovered this quality in the eggs of ants, and others have observed the same gradual enlargement, along with change of shape, in those of other insects. The design of the Creator in this expansible property, is sufficiently obvious, and there are some natural contrivances in certain eggs, the final cause of which we can also distinctly trace. The eggs of the ephemeræ, for example, are smooth and oblong, resembling carraway comfits, a form, which Swammerdam mentions, as admirably adapted for diffusing them through the water, where they are dropt by the mother insect. To prove this, he placed a few of them on the point of a knife, and letting them fall gently into the water, they immediately separated of themselves, in a very curious manner.* The same accurate observer describes a very remarkable appendage in the egg of the water scorpion. This egg is furnished with a coronet of seven bristles, disposed like down on the seed of the blessed-thistle. These bristles closely embrace the egg next to them in the ovary of the mother insect. As these eggs are deposited in the stems of aquatic plants, the bristles, which are partly left on the outside, are probably intended to prevent the aperture from being closed by the rapid growth of the plant. Reaumur gives an interesting description of similar eggs, deposited by a common dung fly. These eggs are furnished at the upper end with two diverging pegs, which prevent them from sinking into the dung, where they are placed by the parent, while they are permitted to enter sufficiently far to preserve them moist. Both circumstances are indispensable to their hatching; for when Reaumur took them out of the dung, they shrivelled up in a few hours, and when he immersed them farther than the pegs, they were suffocated, and could not afterwards be hatched.†

* Book of Nature, vol. i. p. 201. † Reaumur, Mem. iv. p. 37.

A still more remarkable appendage belonging to some insects' eggs, is that of a foot-stalk, evidently intended to place them out of the reach of grubs, which might devour them. The eggs of the lace-winged fly are of this description. They consist of a small oval greenish white head, similar to apple mould, with a white transparent stem, more than an inch high, and not thicker than a human hair, but smaller, and more stiff and rigid. About a dozen of these eggs are deposited by the fly in a single, and sometimes in a double, line, upon the leaves or branches of the elder, and of other trees and plants, abounding with aphides, upon which the grubs feed when hatched. The foot-stalks of these eggs are formed by the mother fly attaching a drop of gluten to the branch, and drawing it out to the requisite length, before the egg is deposited on its summit. As she uses her body for a measure, the foot-stalks are all of one length. They are so smooth and slender, that the grubs could not climb upon them.

Many eggs are immersed in a glutinous liquor, by which they are made to adhere to trees, or other substances, where they are deposited, or united together in various forms, and for various purposes of safety. In the 'Winter' volume, I noticed the remarkable instance of the gipsy moth, which, by means of this gluten, not only fixes her eggs to the tree and to each other, but covers them over with down taken from her own body, to preserve them from the inclemency of the weather. A still more admirable use of this glutinous fluid is made by the common gnat, which is too curious to be passed over. It is described by Reaumur, who, by repairing to a pond, or bucket of standing water before five, or at latest, six in the morning, frequently witnessed the remarkable operation; and it has also been seen and described by other naturalists.

The problem of the gnat is to construct a boat-shaped raft which shall float, of eggs heavy enough to sink in water, if dropped into it one by one. The eggs are nearly of the pyramidal form of a pocket gunpowder-flask, rather pointed at the upper, and broad at the under end, with a projection

like the mouth of a bottle. The first operarion of the mother-gnat is to fix herself by the fore-legs (four in number) to the edge of the pond, or on a floating leaf, with her body level with, and resting upon, the surface of the water, excepting the last ring of the tail, which is a little raised. She then crosses her two hind legs in the form of an X, the inner opening of which is intended to form the scaffolding of her structure. She accordingly brings the inner angle of her crossed legs close to the raised part of her body, and places in it an egg covered with gluten. On each side of this egg she places another, all which adhere firmly together by means of their glue, and form a triangular figure, which is the stern of the raft. She proceeds in the same manner, to add egg after egg, in a vertical (not horizontal) position, carefully regulating the shape by her crossed legs. As her boat increases in magnitude, she pushes the whole gradually to a greater distance, and when she is about half finished, she uncrosses her legs and places them parallel, the angle being no longer necessary for giving the proper shape. Each raft consists of from 250 to 350 eggs, which, when all laid, float on the water secure from sinking, and are finally abandoned by the mother. They are hatched in a few days, the grubs issuing from the lower end; but the boat, now composed of the empty shells, continues to float till it is destroyed by the weather.* Kirby describes this little vessel as resembling a London wherry, being sharp and high, as sailors say, fore and aft, convex below, and concave above, and always floating on its keel. 'The most violent agitation of the water,' he adds, 'cannot sink it, and what is more extraordinary, and a property still a desideratum in our life-boats, though hollow, it never becomes filled with water, even when exposed.'

The sequel of this remarkable mode of reproduction is not less curious. The larvæ, when hatched, drop to the bottom of the water, and are there transformed into pupæ. About eight or ten days after this transformation, the pupa prepares, generally about noon, for emerging into the air, raising itself

* Reaumur, Mem. iv. p. 621.

up to the surface, so as to elevate its shoulders just above the level of the water. It has scarcely got into this position for an instant, when, by swelling the part of its body above the water, the skin cracks between the two breathing tubes, and immediately the head of the gnat makes its appearance through the rent. The shoulders instantly follow, enlarging the breach. The most important, and indeed indispensable, part of the process, is the maintaining of its upright position, so as not to get wetted, which would spoil its wings, and prevent it from flying. Its chief support is the envelope which it is throwing off, and which now serves it as a life-boat, till it gets its limbs set at liberty and trimmed for flight. The body of the insect serves this little boat for a mast. When it has extricated itself all but the tail, it first stretches out its two fore-legs, and then the middle pair, bending them down to feel for the water, upon which it is able to walk as upon dry land,—the only aquatic faculty which it retains after having winged its way above the element where it spent the first stages of its existence.*

This is but one instance, though a very striking one, selected out of cases almost innumerable, in which astonishing and unexpected means are made use of for the preservation of animals, and especially of insects, in their earliest state. In contemplating such cases, imagination seems scarcely to keep pace with the reality. Here is a creature, committed, in its embryo form, to the surface of the water, in a life-boat constructed and launched by a parent to whom submersion is death; sinking, when developed, to the bottom of these waters, to which its life is fitted, where alone, indeed, it can live, and where it passes from one stage of existence to another; then, at the appointed time, rearing its head above its watery habitation,—becoming all at once an inhabitant of another element, spurning both the water and the land, and floating aloft on transparent wings in the balmy air. The transformation of insects, itself a miracle, is familiar to us; but the circumstances attending the changes of this little gnat

* Insect Transformations, pp. 317, 318.

seem to have been contrived for the express purpose of exhibiting, in peculiarly interesting and remarkable combinations, the various properties of Creative skill, contrivance adaptation, and forethought. So that, were there no other proof of these attributes in the universe, it would be impossible to mistake them here, or to withhold from the Creator the tribute of admiration.

FIFTH WEEK—SUNDAY.

ON THE UNIFORMITY OR SAMENESS IN THE NATURAL AND MORAL WORLD.

Alter et idem may with fitness be inscribed on every thing in creation. The living spectators are shifted, the spectacle continues the same. 'The sun ariseth, and goeth down, and hasteneth to his place whence he came.' His rays fall for the first time on the eye of infancy, and for the last on those of age; but they warm the bosom of the same earth, illumine the same mountains, and gild, as yesterday, the same firmament of clouds. 'The wind goeth toward the south, and turneth about unto the north, it whirleth about continually.' It propelled the rich argosies of Venice over the blue waves of the Ægean, and wafted on its course the timid bark that crept along the Grecian shore—just as to-day it swells the sails of the deeply laden and adventurous Indiaman, and carries to his station the messenger, whose purpose it is to publish the story of peace to the heathen. It is the same breeze that plays in the branches of the oak to-day, which waved them in the sight of our forefathers. The tree, the air, the light are the same, but the eyes are changed. Yet it is probable that the contemplation or enjoyment with which they are observed is very similar.

Change is an indication and sure companion of imperfection. With the great Author of the world there is no change.

The laws of instinct continue to descend through growing ages unaltered. The seasons, circling in harmonious round, continue in unalterable succession. But that which is unvarying to centuries, is new to man—and what is uniformity with God, with us is vicissitude. Length of days, experience, and contemplation are requisite to unfold to us that there is nothing new in all the events and feelings of which we are the subjects. The succession of generations, has been but a renewing of the emotions and experiences of the generations that are passed; 'the thing which hath been, it is that which shall be; and that which is done is that which shall be done, and there is nothing new under the sun.'

There is something subduing and tranquillizing in this view of things. Would we madden ourselves with the wild follies of youth, and give a loose to the most unreflecting levity, there have been thousands of hearts as vain and light as ours, glorying in juvenile strength, and rioting in unbridled merriment—but where are they now? Would the sterner powers of manhood prompt us to do and to dare bravely, to achieve reputation at the expense of unceasing exertion, and unrelaxing energy—the brave, the wise, the energetic, have tried it all before us. No steep that we would climb lies yet untrodden. Each bears the trace of many a resolute foot-mark, and many a hard conflict—but they who traced them, where are they now? Does disappointed hope press us to the earth;—has sudden grief driven us to all the extremity of woman's anguish; have we beat the breast, torn the hair, and tossed up the helpless hands in desperation:—Think you that your breast alone has been so beaten, your hair alone so torn? Ah, no! Whatever has been experienced by you, has been the portion of a thousand others. They too have wept, have groaned, have refused *ever* to be comforted; and where are they?

'He grieved—but now his griefs are o'er;
He joyed—but his delights are fled;
Had friends—his friends are now no more;
Had foes—his foes are dead.'

Not the wind only, but the times and tides of man 'whirl about continually, and return again according to their circuit.' Is thy case perplexing? Depend upon it, it is not new. Is thy woe profound? Trust me, there has been deeper. Is thy condition hopeless? Oh, say not so! It hath an end; and thou shalt change, and look back with wonder on the soaring of thy delights, and the profundity of thy despairs—and yet thou shalt be conscious that thou art the same, and never, in any change, losest thy identity. Thou shalt be sensible that the whole system of thy hopes, and fears, and cares, are altered, and yet that thou art the same being that experienced them once, and experiences them no longer. There is something within thee that forms *thyself*, and *thyself* alone; and no event can deceive thee, or beguile thee into the belief that thou art another. Adam, the world's great patriarch, endowed with strength, without the consciousness that it could fall into weariness; with sight, that gazed upon the sun unquailing; with mind, that grasped and admired the wonders of creation; with soul, that communed with the Holy One, and trembled not, but rejoiced—Adam, poor Adam! the outcast, the toil-worn, the defenceless, the weeping father of bleeding Abel, the soul-stricken father of vengeful Cain, still failed not to recognise himself—to feel his miserable identity clinging to him—to own in his bleeding heart's core, that he *was* the man—that he *is* the man. And Adam, the subdued, the reduced to obedience, the atoned-for, the reconciled, though restored to the power of prayer, consoled, renewed in the spirit of his mind, conscious of another nature sprung up and growing within him—still would look back to what no other man could contemplate, and through the three solemn changes, each of which seems enough to extinguish identity, would feel that he was, and had ever been, the same.

Mysterious consciousness! hidden in thy springs, but efficacious in thy influence—like the power of conscience, clinging and cleaving still unsought, unbidden, undesired by us, but ever present, ever influential!—the God who gave our being, gave us thee; and thou, a deathless principle, will ad-

here to us for ever. The grave will hide the hand that holds the pen; the worm will consume for its necessities the frame which now walketh upright on the earth; its ashes may be dissipated or scattered; but the spirit that once inhabited that tabernacle, hath entered its place of waiting, naked, but not unmindful of its former dwelling; lingering till its reunion be completed, and perfectly aware of that which was its own. O! solemn hour of reunion, when those who are in their graves shall hear—those who have been deaf and dead for centuries shall awake to the voice of the last trumpet, and, rising, find themselves again tenanted by the ancient partner, the companion, it may be, of many offences, many woes, many unbeliefs, many reasonings, many conflicts. There will be there no mistake. No ransomed dust will be made the dwelling-place of an impenitent spirit. No frame unrenewed shall be able to take for its partner in hatred a soul that has been sanctified. He who said and it was done, who commanded and it stood fast, will restore all things to order and beauty, and gather into the mansion prepared by the gracious Forerunner, every renewed one rejoicing in its conscious identity, and blessing and praising Him who hath made it another, and yet left it the *same*.

Reader, hast thou ever contemplated the certainty of this consummation of all things? Hast thou thought what may be thy position, when thy mortal is putting on its immortality, when thy now corruptible and perishing frame shall be assuming incorruptibility? How may it be with thee then? Is it not possible that thy spirit, restored to its ancient tenement, may howl around it, and long to make its escape? Would not Dives rejoice to exchange his being with Lazarus, even at the price of being extended at his own gate, subject to the mercies of the dogs? May it not be, that those who may have been the objects of thy contempt or derision, are now 'comforted,' and thou 'tormented?' Wouldst thou change places with the humblest and most despised of the company of the redeemed? Think of it now, thou canst not. Thy identity, thy terrible identity, will adhere to thee, like the poisoned

shirt to Hercules. The soul that rebelled must die, the members that sinned must suffer. They must be reunited in a union of woe. Thou canst neither escape from, nor lighten the anguish. Thou art the same; thou didst choose to be the same; and thou must continue the same through eternity.

Shall the rivers return again to the ocean whence they came, shall the wind veer about till it recover its former position, shall all things exhibit a tendency to approximation towards that from whence they sprung, and shalt thou remain unchanged? Wilt thou not hasten to become *another*, and yet the same? Thou hast sprung from God, thou wert made for God, thou hast been ransomed by God.—Wilt thou not return to God? Rest not till the enigma is interpreted, how thou canst retain thine identity, yet change thy passions, thy hopes, thy very destination. And when thou shalt witness the new buds on the ancient trees, and the fresh verdure springing from the seemingly withered herbage, go and learn what is meant by bringing forth fruit to His glory, whom hitherto thou mayest not have glorified, and by delighting in His service, whom in time past thou mayest not have served.

M. G. L. D.

FIFTH WEEK—MONDAY.

REPRODUCTION OF INSECTS—CARE OF THEIR OFFSPRING, EXEMPLIFIED IN BEES AND WASPS.

In the volume on 'Winter,' I particularized, among the *hybernating* instincts of other insects, those of the *bee;* and in turning to the reproductive instincts of this order of the animal creation, the bee seems still to claim our peculiar notice. It is true that spring is not the season in which the bee, any more than numerous other tribes of the same genus, exercises, to any great extent, its reproductive powers, though it is in this season that it makes the first great preparations for the

fulfilment of that important function; and, were I to follow rigidly the precise order of time, I might perhaps be induced, either to postpone the whole subject, as connected with this wonderful insect, to the summer division of my labours, or at least to confine myself to the consideration of its building instinct. But it seems more convenient to connect together the various phenomena of reproduction, as exhibited in the different orders of living beings, without strict reference to the arrangement of time; and, therefore, I shall now treat of such of the habits and functions of this interesting little animal, as relate to the propagation of the species.

Referring to the sketch contained in the 'Winter' volume, of the instincts belonging to the four different *castes* which inhabit a hive of the common working bees, I begin by noticing the preparations which are made for the future progeny; and this necessarily includes some account of the construction of their cells. As soon as a swarm of bees enters a new hive, they begin to make cradles for the residence of the expected offspring, as well as storehouses for the hoarding of their food. These are, in fact, the same little chambers, or at least chambers on a precisely similar construction. They are composed of wax,—a substance which was long believed to be extracted from flowers, but has now been ascertained, beyond all doubt, to be a secretion exuded through the openings of the rings formed by the scales of their bodies. Their mode of operation, which is sufficiently curious, is said to be as follows:—They commence by clustering, as it is called, which is effected by two bees taking hold of the roof of the hive, at a certain distance from each other, and others clinging to their legs, and to each other's, so as to form long rows, like garlands or strings of beads. Many such strings form a cluster. In this way they remain for twenty-four hours, almost without motion, and meanwhile the necessary secretion has been going on, and by-and-by the wax may be seen at the edge of the rings, which then appear bordered with white. 'At last a bee comes out from the crowd, clears about an inch, by driving away the others with his head, and, settling in the

middle of this space, begins to lay the foundation of a comb, which is a flat piece of wax, composed of a great number of cells. These cells are joined to each other's sides, and placed in a double row, end to end, so that each side of the comb is full of holes, fit for containing eggs or honey. The bee, we have just mentioned, pulls out the little cakes one by one from its wax pockets, holds them in a pair of pincers, with which its legs are furnished, and works them about with its tongue, which is as useful as a trowel. When these are fixed to the roof of the hive, it disappears among its companions. Other bees follow this example, adding their little store of wax, until a lump is formed large enough to work upon. The cells are then formed by another set of labourers; and a third party finish and polish the work, by drawing their mouths, their feet, and their whole bodies over it, again and again, until it is quite smooth.'*

While many labourers are thus employed, others are industriously engaged in collecting food, which, after satisfying their own appetite, they bring to those that are working at the cells, that they may not be interrupted. When the labourer is hungry, he bends down his trunk before the bee that is to feed him, which pours a few particles of honey into it, and, thus satisfied, he proceeds with his task.

The hexagonal form of the cells has been deservedly admired, as a remarkable instance of instinctive wisdom,—a wisdom not belonging to the bee, but to Him who created it. It may be demonstrated to be the best possible shape, for consuming the least wax, and filling the smallest space.—The manner, too, in which the cells are constructed, the sides of one cell forming the centre of the bottom of the opposite, is a most skilful contrivance for strengthening the whole structure of the comb, which ought not to escape observation. Neither

* 'Insects and their Habitations.'—This pleasing little book for children contains distinct and accurate descriptions, of which, when they have answered my purpose, I have freely availed myself, as the information is drawn from the best sources, and the work, humble as are its pretensions, exceedingly interesting and useful.

should it be forgotten, that, although the range of the comb is perpendicular, that of the cells is not precisely horizontal, as it would be, were they placed at right angles to its plane; they are uniformly sloped slightly upwards, to such an extent as, when assisted by the pressure of the external air, prevents the liquid from flowing out.

When these preparations are sufficiently advanced, and the season is favourable, the queen-bee, which is the mother of the whole progeny belonging to the colony, having hitherto superintended the entire operations, and, by her presence, given vigour and animation to them all, without, however, taking part in the work herself, commences her peculiar functions. In a single aerial excursion, having found a husband for herself in one of the drones, she begins to lay her eggs, which she deposits, one by one, in the cells, by the insertion of the hinder part of her body. In a day or two, a little worm is hatched from each egg, the heat of the hive, kept up by a numerous swarm, being sufficient for that purpose. This little maggot is at first rolled up, at the bottom of the cell, in the form of a ring; and, as soon as it is so far advanced as to require food, this is carefully supplied by the *nursing* bees, from stores of bee-bread, previously prepared from the *pollen* of flowers by the forethought, or rather by the remarkable instinct, of the particular class to which this office belongs. In about ten days, the worm is full grown, and its attentive nurses, knowing that it will require no more food, seal up its cell with wax. It then spins for itself, like the caterpillar, a soft web, and is changed into a *chrysalis*. In this state it undergoes its final transformation, and, after about ten days of sleep, breaks open the seal, assisted by the nurses, and comes forth a perfect bee. No sooner has it come to the surface of the comb, than it cleans itself with its legs, and then immediately unites with the rest of the swarm in the active duties of its caste.

As soon as the young bee is freed from its cradle, the queen, without waiting to clear away the silken swaddling band with which it was enveloped, supplies the place with

another egg. Thus the breeding-comb is kept full; and it is said that a single queen sometimes produces no fewer than sixty or seventy thousand young bees in one year. Of course, a hive of an ordinary size cannot possibly contain so numerous a progeny, and colonies are sent off; or, otherwise, contrivances, such as I have mentioned in the 'Winter' volume, are resorted to, to prevent the *casting*, as it is called, and to induce the supernumerary population to settle quietly down by the side of the parent stock.

Besides the domestic bee, whose instincts and habits are so well calculated to raise the mind to the contemplation of that Divine Intelligence, from whom it so obviously derives the whole mysterious impulse by which its actions are regulated, there are several other families of the same species, which differ from it, not only in their appearance, but in their modes of operation.

Of these, I shall first notice the *carpenter bee*, a solitary worker, one of the most remarkable of which, distinguished by beautiful wings, of a deep violet colour, is not found in this country. With her two strong teeth, she chisels out a hole in some decayed wooden post, to the depth of twelve or fourteen inches, making it as smooth and neat as if she had used the tools of the tradesman whose name she bears. Here she places her eggs, at intervals, in the following remarkable manner:—Having deposited an egg, along with such quantity of pollen as it will require in its state of a grub, she forms a compact covering for it, by gluing together, with her wax, pieces of the dust she had formed in boring. These she most ingeniously, and with great industry, unites to each other, till she has completed a partition, about the thickness of a half-penny. This partition, which closes up the first-laid egg, forms a solid bottom, on which she deposits another, with an additional quantity of pollen; and so on, cell after cell, one above another, till, in the course of some weeks of hard labour, she has filled up the whole tube, carefully stopping up he entrance at last, to prevent the intrusion of enemies.

But this is not all. The little workman, as if foreseeing

that the eggs which were first laid would be first hatched, and that, unless some provision were made for the escape of the elder bees, they would be kept prisoners till those which were younger by several days had come to maturity, and had made their escape, does not consider her maternal task completed, till she has bored a hole at the bottom of the tube, to the open air, by which they may effect their deliverance, one by one, according to their ages, each having only to gnaw through its own cell, into those left open by the bees which have already disengaged themselves. Another remarkable circumstance is, that, in turning into a chrysalis, each grub places itself with its head downwards, as if conscious of the way prepared for it to make its escape.

The wasp, another solitary labourer of this wonderful class, has no power of exuding wax from her body; but she is led, by her natural instinct, to supply this want in a very remarkable manner. By masticating the fibres of wood, and moistening them with a gummy liquid, which her mouth supplies, she kneads them into a kind of paste. With this she lines the roof, sides, and bottom of a cell, which, if she has not been fortunate enough to find ready formed, she has excavated for herself in the earth, to the extent of about a foot square, or sometimes considerably more. The paste is spread, by means of her tongue and feet, into very thin layers, with spaces between, of which she employs fifteen or sixteen, as an envelope, to secure her habitation from damp and external injury, thus making the walls about two inches thick. She then forms her combs of the same material, across the interior like a hanging floor, supporting them with rods, of about an inch long, fixed to the roof. The cells are as neatly shaped as those of a bee-hive; and nothing can be more wonderful, than that one unaided and feeble insect should be able to perform so much, and with such singular art; and all, too, for the accomplishment of a future object, of which she cannot be believed to form any idea—the propagation of the species. Could it be supposed, that she was influenced by imitation and experience, the mystery would not be solved;

because the question would still recur, Whence did the first wasp derive her skill, and how did she impart it to her progeny? But, in the present instance, even this modification of the wonder is entirely excluded; for it has been ascertained, that a wasp survives only one summer, and a female of this class can, therefore, never have seen the duties of a mother performed by her own parent. They lay up no winter provision, and the species is preserved by a very few of the youngest and strongest out-living the privations of the cold season in a torpid state, while all the rest, amounting to thirty or forty thousand in a swarm, perish in their nest.

When the queen-wasp has finished a few cells, and laid her eggs in them, she intermits her building labours, to collect food for the young grubs, which will soon be hatched. In a few weeks these become perfect wasps, and work with the parents in making new cells for the future brood, and in the duties of feeding and nursing the young. By the end of summer, there are, on an average, not fewer than from fifteen to sixteen thousand cells; and, as several wasps are produced in succession from a single cell, it has been calculated, that one female may produce a progeny of above three hundred thousand!

When we remember, that the astonishing labours we have been describing, belong but to one class of instincts impressed on a single order of tiny and feeble insects, in whose history, and in the history of whose whole genus, every thing is surpassingly wonderful, we feel that language has no words to express the admiration with which our hearts are filled. Let the contemplation exalt our views of the infinite and ever-glorious perfections of the Creator. Every where his hand is visible; but it appears to me, that he never lays it more bare to the view of mortals, than in the instinctive propensities with which he guides the irrational world of living beings to fulfil his high behests.

FIFTH WEEK—TUESDAY.

REPRODUCTION OF INSECTS.—THE MOTH—THE BURYING-BEETLE —THE ANT.

This paper shall be devoted to a detail of some other instances of peculiar instincts among the insect tribes, relating to the propagation of the species.

The previous observations on bees lead me to notice an insect, which seems intended by Providence to preserve the balance of living beings, by carrying destruction into the colonies of these industrious creatures—an application of a principle which we have already observed to be established as a universal law of Nature, relating to organized existences.

Bees, like other animals, have many enemies, which prey upon themselves, or their stores. Among these, perhaps, there are none more formidable than various kinds of moths. Night is the time when the latter fly about, and, as bees do not see distinctly, except in a strong light, the moths frequently elude their vigilance, gliding in between the guards stationed at the mouth of the hive, which these creatures take special care not to disturb. If, however, the approach of the enemy is discovered, the daring attempt proves fatal; for the watchers immediately utter a loud hum of alarm, which brings many to their assistance, armed with their deadly stings, and the intruder is despatched without mercy. When, however, the wily moth succeeds in gaining admittance, she then, by the rapidity of her motions, generally escapes her pursuers, even when some of the watching bees become aware of her intrusion. Having accomplished this, and ensconced herself in a secure corner of the hive, she lays her eggs, which was the only object that induced her to incur the danger; for neither the bees, nor any part of their stores, can afford the means of subsistence to herself, although the wax is the proper food of the young grubs, which are to proceed from the eggs. As soon as they are hatched, each grub forms a wind-

ing tube in the wax, sometimes eighteen inches long. These tubes are lined with silk, which the bees are unable to pierce, and thus the grubs remain secure amidst the poisoned weapons of their enemies. They bore through the wax in every direction—no part is safe from their ravages, and the bees are frequently compelled to yield all the fruits of their industry to these formidable spoilers, and to leave them in entire possession of the hive.

I shall next advert to the extraordinary habits of another insect, of a nature altogether different from those already mentioned, but not less strikingly indicative of beneficent intention in the Creator, who formed its frame, and inspired its propensities: I allude to the burying-beetle.

It may seem strange to those who reflect on the mortality which takes place among all the races of animated nature, that so few dead bodies meet our sight in our rural walks, and so few of those nauseous and pestilential smells, which arise from animal substances in a state of decay, assail our olfactory nerves. One obvious and very extensive cause of this is, doubtless, that natural law by which one animal is made to prey upon the dead carcass of another, or to seize and devour it while yet alive; and the evil consequences which might ensue, were animals endowed with no such propensities, have been frequently and successfully urged as one argument, though by no means the strongest, in defence of a providential arrangement, which, on a cursory view, may appear to militate against the Creator's attributes of benevolence. But the Author of Nature has provided other means, also, by which noxious or disgusting objects are removed from the earth's surface. There are some species of insects, and of animals both of a higher and lower grade than insects, which have been appropriately called Nature's *scavengers*. Of these, one very remarkable family is that whose habits we are now to consider.

The burying-beetle lays its eggs in the putrescent flesh of reptiles, birds, or beasts; and, when the larvæ are developed in the form of maggots, they find this appropriate food pro-

vided for them by the instinctive foresight of their parents. But were the carcasses, so used, to remain above ground, exposed to the free action of the atmosphere, their decomposition would be carried on too hastily, or they might be devoured by those animals which feed on carrion, or many other accidents might befal them. The instinct of these beetles leads them, therefore, to serve a double purpose, by burying the bodies under ground; thus preparing a fit receptacle for their eggs, and, at the same time, removing a common nuisance. The manner in which they accomplish this useful office, is sufficiently curious, as the following experiment will show.

It had been observed, that dead moles, when laid upon the ground, generally disappeared in two or three days, and sometimes within twelve hours. In order to discover how this happened, a mole was laid in a garden, and the place marked. At the end of three days it was gone; and, upon digging where it had been placed, it was found buried three inches deep, and under it were four beetles. To be quite sure that these creatures were the cause of its disappearance, four of the same kind were put into a large glass vessel, half filled with earth, and covered over, so that they could not get out. Two dead frogs were laid on the surface of this earth; and two of the beetles immediately commenced their labours, on one of these bodies, with such vigour, that, in the course of twelve hours, it was completely buried. The other two were idle, during this operation; but, at last, their turn came, and the remaining frog was buried. A dead linnet was then put in. They began by pushing out the earth from under it, so as to form a hole for its reception, and then dragged at its feathers from below, to pull it into the grave. One of them at length seemed to quarrel with the other, and driving it off, carried on the work alone for five hours. He lifted up the bird, changed its place, turned it about, and, from time to time, coming out of the hole, climbed upon it, making apparently an effort to tread it down; and, when he had effected every thing that could be accomplished in this way, he again commenced his work beneath the surface. Being at last exhaust-

ed with so many hours of hard and incessant labour, he came out of his hole, and lay down on the ground without moving, for more than an hour. Again he commenced his work; and, next morning, the linnet was found to be sunk an inch and a half under the surface, with a trench all round it. In the evening, it had sunk an inch lower; and, in another day, it was quite covered up. Other small dead animals were afterwards put into the glass case, until, in fifty days, those four little beetles had buried no fewer than twelve bodies.

The last insect whose operations in propagating and rearing its offspring, I shall notice in this paper, is the ant, that little creature whose instincts bear, in some respects, a strong resemblance to those of the honey-bee, and, in some other respects, appear to be even still more remarkable. The ant-hills are wonderful structures, raised with great skill out of crude and unpromising materials, being composed of earth, moistened with rain or dew, kneaded with their teeth, and beat with their feet. So far as my subject leads me at present to describe them, I have to observe that there is a central apartment or royal cell, to which all the streets and lanes of their city converge, and in which are confined, for life, as in a state prison, their king and queen, two portly personages, whose size, superior to that of all their subjects, prevents them from escaping by the door through which the other denizens of the community find easy ingress and egress. There are various kinds of this insect, each of them remarkable for some peculiarities, but I speak at present of the white ant, one of the most active and singular of the species. Round the royal apartment are erected a number of nurseries for the young, as well as storehouses for the provisions. The storehouses are built, like the greater part of the nest, of earth, but the nurseries are formed of small grains of wood glued together. A pathway, half an inch wide, is often made, winding gradually upwards, within this high building, that it may be easier to climb, with their loads, from one part to another; and even a stair-case, or kind of bridge, resting on one vast arch, is sometimes carried, for the same purpose, from the top to the bottom

of this wonderful dwelling. Tunnels are bored by these little creatures all round their nest, to the distance sometimes of several hundred feet, and of enormous size, compared with that of the building, measuring occasionally nearly a foot across.

Here, as among bees, the important function of producing the future progeny, devolves entirely upon the solitary queen, who is said to lay the enormous quantity of twenty thousand eggs in the course of twenty-four hours. Like the queen bee, too, she is exempted, as well she may, from all the cares of nursing. This department devolves upon a particular class of the community, who show the utmost tenderness for their precious charge, and extreme solicitude for their welfare, carrying them from place to place in their mouths, as occasion requires, and even when their nest is laid open, exhibiting much more anxiety to place the larvæ out of danger, than to attend to their own personal safety. Among some species of ants, the nursing department is very laborious. As soon as the sun's first rays begin to shine upon the nest, the ants that are at the top go down in great haste to wake their companions; and all the young brood are then carried, and laid in the sun for a quarter of an hour. After this they require to be placed in other apartments where they may be warm without being scorched; and every evening, an hour before sunset, they must all be carried down into the lower cells, to be safe from the cold. They are to be hatched, in short, and kept warm by the genial heat of the sun, and the nursing ants must constantly attend to the state of the weather, and regulate their motions accordingly.

In all these instances, how astonishing is the power of instinct, which is accommodated, with such admirable discrimination, to the circumstances of each tribe, and is so full of new and most unexpected resources!

FIFTH WEEK—WEDNESDAY.

REPRODUCTION OF INSECTS.—GALL-FLIES.

One of the most remarkable of the breeding instincts with which we are acquainted, is that which the Author of Nature has bestowed upon the gall-fly family. There is known to be a principle of the vegetable kingdom, analogous, probably, to the *vis medicatrix* among animals, by which a puncture on the leaf, or bark of a tree, causes the sap to exude, and form a new growth of a peculiar description. It has pleased the Creator to make use of this principle, for the protection of the eggs and larvæ of the insects in question. For this purpose, He has bestowed a peculiar instrument for depositing the eggs; and, as is always the case where such an instrument is given, He has endowed the little animal with a corresponding instinct, that it may apply it to its proper use. Mr. Rennie, in his work on 'Insect Architecture,' in the 'Library of Entertaining Knowledge,' gives the following account of this instrument:—'In some of these insects the *ovipositor* is conspicuously long, even when the insect is at rest; but, in others, not above a line or two of it is visible, till the belly of the insect be pressed. When this is done to the fly that produces the current-gall of the oak, the ovipositor may be seen issuing from a sheath, in the form of a small curved needle, of a chestnut-brown colour, and of a horny substance, and three times as long as it at first appeared. What is most remarkable in this ovipositor, is, that it is much longer than the whole body of the insect, in whose belly it is lodged in a sheath; and, from its horny nature, it cannot be either shortened or lengthened. It is on this account that it is bent into the same curve as the body of the insect. The mechanism by which this is effected, is similar to that of the tongue of the woodpecker, which, though rather short, can be darted out far beyond the beak, by means of the hyoid bone,* being thin and rolled up,

* A forked bone at the root of the tongue.

like the spring of a watch. The base of the ovipositor of the gall-fly, is, in a similar way, placed near the anus, runs along the curvature of the back, makes a turn at the breast, and then, following the curve of the belly, appears again where it originates.'*

With this instrument the mother gall-fly pierces the part of a plant which she selects, and 'ejects into the cavity a drop of her corroding liquor, and immediately lays an egg or more there. The circulation of the sap is thus interrupted, and thrown, by the poison, into a fermentation, that burns the contiguous parts, and changes the natural colour. The sap, turned from its proper channel, extravasates and flows round the eggs, while its surface is dried by the external air, and hardens into a vaulted form.'† This is the account given by one of the older naturalists, and generally followed, though we may be permitted to doubt the deposition of the poisonous drop, which is purely conjectural, and seems unnecessary to account for the phenomenon. Mr. Rennie's conjecture is, that, like the saw-flies, the gall-fly, after the puncture is made, and the egg is pushed into the hole, covers the place over with some adhesive gluten or gum, or the egg itself may be coated over, like those of the moth, with such a gluten. In either of these two cases the gluten will prevent the sap that flows from the puncture, from being scattered or wasted; and the sap, being thus confined to the space occupied by the eggs, 'will expand and force outward the pellicle of gluten that confines it, till, becoming thickened by evaporation, and exposure to the air, it at length shuts up the puncture, stops the further escape of the sap, and the process is completed.'

But whatever the means may be, by which the effect is produced, it is perfect of its kind, and most admirably answers the end intended by the Almighty Contriver. In their most common form, the galls produced by means of these insects, may be found, in great numbers, during summer, on the

* Insect Architecture, pp. 371, 372.

† Spectacle de la Nature, vol i. p. 119.

leaves of the rose-tree, the oak, the poplar, the willow, and many other trees, in the globular form of a berry, about the size of a currant, and usually of a green colour, tinged with red.

When this pretty excresence is cut into, it is found to be fresh, firm, juicy, and in the centre hollow, where there is either an egg or a grub safely lodged, and protected from all ordinary accidents. Within this hollow ball the egg is hatched, and the grub feeds securely on its substance, till it prepares for its winter sleep, before changing into a gall-fly in the ensuing year.

Most of the gall-flies deposit only one egg at a time, and, when that is the case, the gall generally assumes the form we have described; but the insect which makes use of the wild rose-tree, deposits several in one place, making probably as many punctures as she lays eggs. In this case there is a much more abundant flow of sap from the wounds, and the effect is singular and admirable. The sap, instead of being evaporated or lost, shoots out into a reddish coloured fibrous bristle, about half an inch long, studded all over with a kind of pricklets, not unlike the moss on the flower-shoot of the moss-rose. This substance, within which the embryos of the future grubs are placed, is called *bedaguar*, by botanists. It swells to the size of a crab or small apple, and forms a bulb, having the appearance of a tuft of reddish-brown moss, stuck on or round a branch. Each member of the congeries is found, on examination, to be furnished with its own tuft of bristles, arising from the little hollow globe in which the egg is lodged.

'The prospective wisdom of this curious structure, is admirable. The bedaguar grubs live in their cells through the winter; and as their domicile is usually on one of the highest branches, it must be exposed to every severity of weather. But the close, non-conducting, warm, mossy collection of bristles, with which it is surrounded, forms, for the tender grubs, a snug protection against the winter's cold, till, through the influence of the warmth of the succeeding summer, they undergo their final change into the winged state,—prepara-

tory to which, they eat their way, with their sharp mandibles, through the walls of their little cells, which are now so hard, as to be cut with difficulty with a knife.'*

Another structure, similar in principle, but different in appearance, is very common upon oak trees, the termination of a branch being selected, as best suited for the purpose. The structure is rather larger than a filbert, and is composed of concentric leaves, diverging from the base, and expanding upwards, somewhat like an artichoke. Whether this leafy substance is caused by a superinduced disease, as the French naturalists think, or, more probably, by the tendency of the exuding sap of the oak to form leaves, has not been ascertained; but that it is intended, as in the case of the bedaguar, to afford an efficient protection against the weather to the enclosed eggs or grubs, there can be no doubt.

That galls, of various kinds, are formed by the puncture of different species of flies, is evident, from what occurs upon the oak, on which are found two sorts of galls, of a structure quite different from that already described. One of these is the well-known oak-apple, which is commonly as large as a walnut, rounded, but not quite spherical. The skin is smooth, and tinged with red and yellow, like a ripe apple. At the base, there is, in its earlier stage, a calyx or cup, of a few small brown scaly leaves, but these fall off as the season advances. If an oak-apple be cut transversely, there is brought into view a number of oval granules, each containing a grub, and embedded in a fruit-looking fleshy substance, having fibres running through it; and, what is particularly remarkable, each of these fibres terminates in one of the granules, like a footstalk, or rather like a vessel for carrying nourishment.

The gall-insects are very various in their form and habits, some of them belonging to the tribe of aphides; and the galls they produce are not less diversified. These structures may be found on every part of a plant, whether branch, root, leaf, or bud. Nor are they confined to trees;—on thistles, on the

* Insect Architecture, p. 377.

ground ivy, and the germander, as well as on many other plants, they may be discovered. Some galls, found in foreign countries, are collected in great quantities for sale; and the gall-nut of a species of oak is particularly valuable, on account of its use as an ingredient in making common writing ink.

There is something so very striking in the creative contrivances and adaptations observable in this mode of providing for the safety and future subsistence of the progeny of these insects, as to afford peculiar satisfaction and delight to an ingenuous mind inquiring into the existence and attribute of the Great First Cause. Let us take a summary view of the whole process. The problem is, what new means may be employed for affording a secure asylum, furnished with appropriate food, to the embryo of certain races of living beings. Vegetable nature possesses a property, by which the sap, when exuded under very particular circumstances, will form itself into a round hollow excrescence; and this is fixed upon for the intended object. The animals whose offspring are to be thus reared, are furnished with eggs fitted to be hatched in such a situation, and to produce grubs whose food this very exudation shall afford. They are at the same time, supplied with a most curious instrument, elaborately formed and fitted in the most exact manner for making the particular puncture required in the plant selected; and then they are endowed with an instinct which enables them to choose the precise plant, whether tree, shrub, or flower, to which the egg, the future grub, and the instrument, are all most curiously adapted; and to choose also the proper part of the plant, whether leaf, branch, stem, or root; and, still further, to deposit their eggs at the critical season, when circumstances all combine most favourably for the required flow of the sap, and for the production of the grub in such time as to be ready for its state of hybernation when winter arrives;—all these, and various other circumstances, so evidently evince knowledge, contrivance, and forethought far beyond those of the animals

which they actuate, as to form a combination of evidence in favour of an Intelligent Creator, at once amazing and irresistible.

FIFTH WEEK—THURSDAY.

REPRODUCTION OF INSECTS.—DEPOSITION OF EGGS IN THE BODIES OF ANIMALS, AND IN INSECTS' NESTS.

Before leaving the subject of the maternal instincts of insects, I must not omit to mention that the same kind of analogy is to be found here which pervades other departments of the animated world, I mean that of one species of animals being reared or nourished at the expense of another. One or two examples of this provision, which, although somewhat startling on a first view, can yet be distinctly proved to be altogether consistent with that peculiar character of Divine wisdom and benevolence manifested in sublunary affairs, and productive of a preponderance of good, will be detailed in the present paper.

Yesterday some account was given of those very peculiar provisions by which the vegetable kingdom is laid under contribution for the hatching and rearing of the grubs belonging to certain species of flies, by the formation of galls. Such of my readers as are familiar with the analogies of Nature, will not be surprised to discover that, by a similar provision, the animal world is made to contribute to the same object.

No person who has resided in a rural district during the warm weather of summer, can be ignorant of that sudden and uncontrollable impulse which so frequently seizes an herd of cattle, known by the appropriate name of *Startling*—when they run off across a field in full gallop, with their tails poked out behind them, and their necks stretched to the utmost length. Virgil, in his 'Georgics,' gives a graphic description of this simultaneous fury of these naturally quiet and patient animals, which he justly attributes to the terror arising

from a little buzzing insect. The following is a nearly literal translation:—

> Around the groves of Silarus, and glades
> Of green Alburnus, buzzing sharp and wild,
> An insect pest appears—Asilus named,
> But Œstrus by the Greeks.—The madden'd herds,
> Roused by the hated sound, fly far and wide,
> While woods and arid banks of Tanagrus,
> Echo the lowings through the startled air.*

This terror does not appear to be occasioned by the pain of the inflicted wounds, for it is very doubtful if the ovipositor penetrates the skin, but rather by the well-known buzz of the insect. Were it otherwise, the cattle would, in all probability, lash the fly off with their tails. Their instinctive fear prevents this, and causes them to run recklessly forward, as we have seen, with extended tail, while the little animal is securely performing its parental office. The *startling* may be the means intended by the Creator to prevent an overproduction of the insect. Be this as it may, the egg glued probably to the scared animal's hair or skin, is soon converted into a grub, being hatched by the natural heat and perspiraton of the beast, and eats its way slowly under the skin, causing a lump as large as an acorn. The horse, the sheep, the reindeer, and various other quadrupeds, are subject to the same kind of annoyance; and the gall-bumps, made by the larvæ, are well known to those who have them under their charge. The farmer does not consider his cattle injured by the fly, which is said generally to select the young, and those which are in best condition.

There is a still more remarkable instinct of the kind I am now considering, similar to that which actuates the cuckoo,

> * Est lucos Silari circa illicibusque, virentem
> Plurimus Alburnum volitans, cui nomen Asilo
> Romanum est, Œstrum Graii vertere vocantes;
> Asper, ascerba sonans; quo tota exterrita silvis
> Diffugiunt armenta; furit mugitibus æther
> Concussus, silvæque, et sicci ripa Tanagri.
>
> *Geor.* iii. 146

that leads a certain class of *Ichneumon** flies to deposit their eggs in the nests of other insects. It is, indeed, the practice of a great number of insects of different orders and families, to take advantage of the labours of others of the same genus, in providing for their future progeny. The example which I shall now select, may serve as a curious specimen of this instinct.

The ovipositor of all the true ichneumons is similarly constructed, consisting of a borer enclosed in a sheath, which opens through its whole length, like the legs of a pair of compasses. It is longer or shorter, and stronger or more slender, according to the substances which it may be necessary to penetrate when the eggs are deposited; but the description of the ovipositor of the fly, of which I am now about to give an account, may suffice to give the reader a tolerably distinct notion of the others. Being intended to penetrate into the deep holes dug by mason-wasps, the ovipositor of this insect is nearly three inches long, and as it is not concealed in the body like those of the gall-flies, it appears like a tail formed of a long black bristle. On examining this a little more narrowly, we find that what appears to be a single bristle is in reality three, the two side ones forming a sheath, and the middle one a borer or brad-awl, for piercing the clay barricado of the mason-wasp's nest. The termination of the borer is not, however, smooth, like that of a brad-awl, but toothed like a saw, only the teeth (seven or eight) are not oblique, but perpendicular, a form better fitted for acting upon clay, as the teeth will not become so easily clogged, and the instrument will be more readily drawn back.

That the nature and intention of the operation within, may be understood, it will be proper that I should first describe the nest of the mason-wasp. It is a narrow hole of about three inches deep, hewn with her jaws in an indurated sank-bank. In the bottom of this nest the careful wasp, after depositing her egg, collects about a dozen full-grown caterpillars of a green kind, which she deposits alive, packing them one upon

* Signifying 'Pryer.'

another, in a spiral form, for they naturally roll themselves up as soon as they are at rest. Having in this way provided for the wants of her offspring in the grub-state, the mother wasp seals up the cell with kneaded clay, thus leaving it apparently well secured both against famine and living foes. It is this nest which the ichneumon fly chooses as the cradle of her own progeny. Reaumur, from his own observation, gives an interesting account of the manner in which this insect effects its purpose. 'I perceived,' says he, 'one of these ichneumons, at the instant it alighted upon the spot, under which so many of the little green caterpillars had been stored up by the wasps. Its long tail, which it carried horizontally, appeared to form but one bristle, though it was really composed of three; and though it carried it on a line with its body, it soon showed me that it was capable both of raising and lowering it, as well as of bending it in various directions, and in different proportions to its length. It moved its ovipositor, so as to bring it into a bent position under its body, protruding it even beyond its own head; taking care to direct it into the barricaded nest of the mason-wasp. But, although the insect appeared not to be disturbed by my observations, yet I was unable to perceive whether the toothed portion of the borer was pushed beyond the sides of the sheath. What I did see, however, convinced me that the instrument was worked in a manner well adapted to make its way through the mortar; for she turned it half round alternately from left to right, and from right to left, as a carpenter would his brad-awl, and employed more than a quarter of an hour, before she succeeded in penetrating to a sufficient depth.'*

It is thus that the ichneumon contrives, without any labour of her own, but simply that of inserting her ovipositor, to find a place of safe deposit for her egg, and of plentiful subsistence for her offspring when hatched. As soon as the grub of this intrusive insect becomes animated, it begins to feed on the prey which its mother has so artfully provided for it,—de-

* Reaumurs's Mem. vi. p. 340.

vouring indiscriminately the larvæ of the wasp, and the caterpillars which the industrious creature has stored up for the subsistence of its own progeny. There is something very singular in these instincts and counter-instincts by which the reproductive principle is at once urged forward and kept within proper check, and by which one animal is made to collect the prey on which the offspring of another is so frequently destined to feed. We may not be able to penetrate all the intentions of Creative wisdom in the cases we have been now considering; and indeed at every step we are forced to confess that the ways of the Eternal are not as our ways, but we assuredly see enough even here to afford us the conviction that an intelligence and a bounty far exceeding our conception, have planned and executed these amazing operations.

FIFTH WEEK—FRIDAY.

REPRODUCTION OF BIRDS.—THEIR EGGS.

Confining myself, for the present, to land-animals, and passing over the reptile tribes, in whose reproductive habits there seems to be little known that is peculiar to the genius, we come at once to that family, which, of all lower tribes, is the most interesting, and whose reproductive instincts and functions, above all, furnish to the lover of nature, such varied sources of elegant amusement and instructive study. I need hardly say that I allude to the feathered tribes.

On entering upon the subject, the first thing to which I will turn the attention of my reader, is the egg, and the various phenomena which occur during its development. The physiologist, as well as the naturalist, has directed his inquiries to this curious and interesting department, and few things have been studied with greater care than this production, which contains, in circumstances convenient for experiment and investigation, the mysterious germ of animal existence.

In external shape, the eggs of all birds are constructed on the same model, some of them, indeed, approaching nearer to a globular form than others, but all of them being more or less elongated, and, in general, having one end very perceptibly smaller than the other. In this respect they differ considerably, in their external appearance, from the eggs of the insect tribes, the form of which is exceedingly diversified. There is always a wise reason both for the uniformity and diversity of the Creator's works; and we shall err egregiously, if we ever imagine that, in these operations, we observe anything approaching either to caprice, or a wanton love of variety. It is true, that the differences in natural objects are manifold and incalculable; and these endless dissimilitudes might lead a careless observer to imagine that they were sometimes resorted to, merely for the sake of change. But a more minute survey will correct this hasty conclusion, and we shall find, that the more intimately we become acquainted with the relative connexions and adaptations of things, the more firmly will the conviction be impressed on our minds, that there is a wise, a sober, and a satisfactory reason for every department and minute feature of the Creator's workmanship. Thus there is an obvious cause of diversity in the shape of insect eggs, connected with the diversity of forms in the various tribes of insect existences; while among the races of birds, there is such a general uniformity, or at least analogy, of forms in their bodies, as readily to account for the similarity in the figure of their eggs. This view is confirmed, by considering the respects in which they differ. In size, birds materially vary; and, in this respect, we observe a like diversity in their eggs. I by no means assert, that the size of the egg bears always an exact proportion to the largeness or smallness of the bird from which it proceeds; for I am aware that this is not correctly the case; but there is here a distinct adjustment, within certain limits, which indicates intention; and the very deviations from the general rule would, doubtless, were all circumstances known, only serve to confirm it.

But, leaving the external appearance of the egg, let us con-

sider what is its constitution within, and the gradual development of the future animal, which so mysteriously proceeds. The egg, as it presents itself to the eye, when opened and examined before incubation, consists, as every one knows, of two substances,—a yolk, surrounded with a tough and transparent matter, called the albumen, or white. In the surface of the former, there is a transparent gelatinous molecule, invested with three pellicles, which constitutes the embryo of the future bird. And here a remarkable mechanical contrivance meets us at the outset. It is of great importance to the development of the animal, that this germ or cicatrice, as it is called, should be always kept particularly warm, by the heat of the mother's body, during incubation. This is provided for by a peculiar and beautiful apparatus, minutely described in the late edition of Paley's Theology,* and illustrated by diagrams. It is enough for our purpose at present, to state, that the contrivance is such as to insure the revolving of the yolk, whichever way the egg is placed, so as to cause the germ to be always uppermost, and thus situated nearest to the body of the bird when she sits upon it.

In watching the progress of development during incubation, the first opaque object discoverable by the eye, is a small dark line, called the primitive trace, formed on the surface of the outermost pellicle. Two ridges then arise, one on each side of this dark line; and, by the union of their edges, they soon form a canal, containing a deposit of a semi-fluid matter, which, becoming darker and firmer, discloses two delicate threads, placed side by side. These are the rudiments of the spinal cord, from which springs the nervous system, so essential to the whole animal being. Next to this fundamental part of the structure, follows the first appearance of the vertebræ, which are seen in the form of minute dots, arranged in two rows, one on the outer side of each of the filaments already mentioned. These soon after form a series of rings embracing the spinal marrow. The formation of these elementary parts of the spine, is followed by the development

* Knight's edition, vol. ii. pp. 284, 285.

of three white tubercles at its upper end, which are the foundations of the future brain. It is remarkable that these first rudiments of the brain correspond to the permanent condition of that important organ in the inferior fishes. They are, however, in birds, quickly folded together into a rounded mass; and meanwhile, the two filaments of the spinal cord have approached and united into one column, the form which they ever after retain. The rudiments of the eye and ear appear even at this early period.

The plan, as it were, of the future edifice having thus been sketched, provision begins to be made for the superstructure. The nutrient juices must for this purpose be brought into circulation, and, by-and-by, certain opaque globules are seen to meander unconfined through the mass of jelly; presently a circular vessel is discovered, along which the fluids irregularly undulate backwards and forwards. A delicate net-work of vessels now begins to appear, which by degrees shoot out in various directions, forming trunks and branches, so as to establish a more regular system. And now, for the first time, the rudiments of the heart are observed at a central point, where the folding of the middle membrane forms first a groove, and then a sac, extended soon afterwards into a tube. To this essential organ, the blood-vessels, previously formed, are gradually united by their shooting out in that direction; and thus the uniform circulation of the blood is established, and the heart, or *punctum saliens*,* as in this part of the development it is called, begins to exercise its functions, as is testified by its quick and regular pulsations. It is still only a lengthened tube, but it soon shows three protuberances, which are the cavities of the future auricle, ventricle, and bulb of the aorta. Afterwards it assumes a rounded shape, by the folding of its parts, the whole of which are coiled, as it were, into a knot; by which means the heart gradually takes the form it is permanently to retain.

When the circulation of the blood is thus established, the digestive organs begin next to appear. Two laminæ are

* Jumping spot.

formed from the folds of the innermost of the pellicles which invest the embryo, and these, uniting, constitute a tube, which gradually expands into several dilated portions, to be afterwards converted into the stomach, crop, gizzard, &c. These new organs, even in this rudimental state, very soon begin to exercise their proper office, by receiving into their cavities, through a tube, temporarily provided for that purpose, the fluid of the yolk, which they prepare into nourishment.

Aeration, as it is called, or an internal communication with the atmosphere, is essential to animal life. This is first provided for by a set of temporary vessels spread over the membrane of the egg, and communicating with the blood-vessels, which receive the oxygen of the air through the pores of the shell, and convey this necessary influence to the blood. The lungs, not being required to exercise their functions till the chick is excluded from the shell, are among the last organs that are formed. The rest of the apparatus necessary for aeration is also tardily constructed, for a similar reason. The construction of the heart, in its early stages, resembles this simple organ in fishes, because the fœtus is placed in circumstances analogous to those of aquatic animals; but, by degrees, the heart is divided into two compartments; the auricle also, by a different process, becomes double, as well as the main artery, which last is afterwards separated into two distinct vessels, the one forming the aorta, and the other the pulmonary artery; and thus a foundation is laid for the double circulation, which the future condition of the animal is to require.

It is not necessary, in a work like this, and it might be tedious, to follow the rest of these wonderful processes through the development of the bony skeleton, the flesh, and the skin, with the various organs of sense and of motion, till the perfect animal is formed.* Enough has been said to introduce the reader to a new world of wonders, in which the adapta-

* If the reader be desirous to know the time when the various developments become visible, the following summary may satisfy him.

At the end of the second day, the heart appears to beat.

At the end of 48 hours two vesicles of blood are seen, with a visible pulsation.

tions and contrivances are not less striking indications of creative skill and forethought, than in any other part of the operations of Nature. Dr. Roget concludes his elaborate account of organic development, with the following sensible remarks, which, in few words, express the views naturally arising from the contemplation of these astonishing operations, and which seem appropriately to sum them up:—

'We cannot but be forcibly struck with the numerous forms of transition through which every organ has to pass before arriving at its ultimate, and comparatively permanent condition. We cannot but wonder at the vast apparatus which is provided and put in action, for effecting all these changes; nor can we overlook the instances of express contrivance, in the formation of so many temporary structures, which are set up, like the scaffold of an edifice, in order to afford the means of transporting the materials of the building in proportion as they are wanted; nor refuse to recognize the evidence of Provident Design, in the regular order in which the work proceeds; every organ growing at its appointed time, by the addition of fresh particles, brought to it by the arteries, while others are carried away by the absorbents, and are gradually acquiring the form which is to qualify it for the performance of its proper office in this vast and complicated system of animal life.'*

At the 50th hour, one auricle of the heart appears.

At the end of 70 hours the wings, and two bubbles, afterwards to form the brain, are distinguishable, as well as one for the bill, and two for the fore and hind part of the head.

Towards the fifth day the liver appears.

At the end of 131 hours the first voluntary motion is observed. In seven hours more the lungs and stomach become visible, soon followed by the formation of the intestines, the loins, and the upper-jaw.

At the 190th hour the bill opens, and the flesh appears on the breast.

On the 210th hour the breast-bone, the ribs, the bill, &c. are visible.

Towards the 240th hour, the feathers begin to shoot out.

At the 264th hour, the eyes appear.

At the end of 355 hours, the bill frequently opens and shuts, and the first cry is heard.

* Roget's Bridgewater Treatise, vol. ii pp. 617, 618.

FIFTH WEEK—SATURDAY.

REPRODUCTION OF BIRDS.—PROSPECTIVE CONTRIVANCES.

'On contemplating,' says Dr. Roget, 'the infinitely diversified chain of means and ends, and of causes and effects, which, during the construction and assemblage of the numerous parts composing the animal machine, are in constant operation, adapting them to their various purposes, and combining them into one efficient and harmonious system, it is impossible not to be deeply impressed with the extent and the profoundness of the views of Providence, which far exceed the utmost boundaries of our vision, and surpass even the powers of the human imagination.'*

The truth of this remark must appear striking and obvious, even in the very short, but, I believe, correct view which I yesterday gave of the progress of animal development, as exhibited in the chick, while yet enclosed in the shell. If we follow the process a little farther, we shall add still more to the proofs of Creative Intelligence, and beneficent intention.

I begin, by observing, in general, that the whole animal apparatus is formed in the egg, not for immediate, but prospective use. At first there is a mere jelly, or what appears to be so; a little farther advanced, and there are bones, and muscles, and nerves. But these lie quite inactive for a long time; the nerve excites no action; the muscles do not move; the joints are not exercised, and are perfected slowly. The period of full development is not arrived; they have not yet received their stimulus to activity. The whole, then, is in a state of preparation. Conduit-pipes without their fluids; glands and ducts without their secretions; sensibilities dormant; and a mechanism quite inoperative: a whole animal system beautifully contrived, but only in prospective contri-

* Roget's Bridgewater Treatise, vol. ii. p. 600.

vance.* Paley makes a similar remark regarding the single organ of the eye and of the lungs. Adverting to the latter, he says, in his own graphic style, 'composed of air-vessels where there is no air, elaborately constructed for the alternate admission and expulsion of an elastic fluid, where no such fluid exists, this great organ, with the whole apparatus belonging to it, lies collapsed in the fœtal thorax; yet in order and in readiness for action, the first moment that the occasion requires its service. This is having a machine locked up in store for future use; which incontestibly proves that the case was expected to occur in which this use might be experienced; but expectation is the proper act of intelligence. Considering the state in which an animal exists before its birth, I should look for nothing less in its body than a system of lungs. It is like finding a pair of bellows in the bottom of the sea, of no sort of use in the situation in which they are found; formed for an action which was impossible to be exerted; holding no relation or fitness to the element which surrounds them, but both to another element, in another place.'†

The temporary contrivances noticed in the previous paper, which are intended to answer the purposes of life in the fœtus, while it remains enclosed in the egg, and which are absorbed and disappear as soon as they have accomplished their object, form a kind of counterpart to those which are prospective, and are no less indicative of design. They are like the wooden frame of an arch, which is necessary for carrying on the work, yet it is to be taken down as no longer of use, but the contrary, when the structure is finished. A temporary contrivance of this kind exists in the *bill-scale*, as it is called, of the chick, which is intended, evidently, for no other purpose than that of a hammer to enable the imprisoned bird to break open the door of its jail, and which drops off a few days after it is hatched. This instrument is a small, sharp

* Sir Charles Bell's Note in Paley's Natural Theology, vol. i. pp. 317, 318.

† Paley's Natural Theology, vol. i. pp. 315, 316.

and hard protuberance on the bill of the chick, which is of itself then too soft to answer this important end, being, at this stage, left in such a state, doubtless, for some object connected with the welfare of the bird. It is curious to remark an instance of the striking uniformity of instincts, in the manner in which the chicks of all species employ this temporary instrument for their extrication. M. Reaumur found, that all chickens chip the shell in the direction from left to right; and that the circle in which they chip invariably cuts the egg at right angles to its transverse axis, and never obliquely.

Another remarkable provision, with relation to the welfare of the chick, immediately before and after its extrusion from the shell, is found in the yolk. The white, or albumen of the egg, goes to the nourishment of the chick while the process of development of organs is proceeding; but the yolk is embraced in the body of the young bird, before it arrives at a state which fits it for living in the open air, and a duct leads from the membrane enclosing this mass of nutriment into the first intestine; and thus is the chick nourished during its first feeble existence.

Add to all this, the formation of a kind of down over the greater part of the body of the chick, while it is yet enclosed in the shell, to serve as a temporary protection to its body when first exposed to the weather, and to afford time for the production of the feathers, which could not conveniently be produced within the narrow and compact bounds of the egg.

There is yet another general observation which I may make here, though it relates to another branch of the process of reproduction—I allude to the well-known fact elsewhere incidentally stated, that some of the larger birds lay fewer eggs than the smaller. There is, in this, a very remarkable attention to what is called the balance of animal nature. Birds of prey breed slowly; those which are the objects of prey breed rapidly, and in profusion. Thus, the eagle, the condor, and the vulture, lay but two eggs at a time, and produce only once in the year. The falcon, the hawk, and the owl, with all their rapacious congeners, produce also sparingly. The

wren, on the contrary, lays ten or even fifteen eggs, and rears this numerous offspring, that they may serve, as it were, to supply the wants of the predatory tribes, to whom their feebleness and unprotected condition render them an easy prey. And so with many other birds. They are prolific in proportion to their exposure to accidents or to enemies; and thus the species is preserved, notwithstanding the destruction to which they are destined. This is a kind of provision which runs through animated nature, and, singular as it is, manifests Creative Intelligence, and that kind of analogy, which, in so many particulars, unites the various departments of creation under one character, and distinguishes the whole as the work of one Almighty Hand.

All these circumstances, which relate to organic reproduction in the first stages of a bird's existence, are so obviously proofs of Divine Wisdom, that they require no further comment; but the argument which they furnish derives particular interest and force from the instincts, with which these developments are connected in the parent bird, which so beautifully harmonize with them, and without which, the powers inherent in the embryo would never be brought into action. This will form materials for some subsequent papers; but before I proceed to this interesting part of my subject, a few observations seem to be called for on the peculiar form and structure of birds, with reference to the element through which they are intended to move. We shall here find no less striking evidences of the contrivances and adaptations of a Creating Mind.

SIXTH WEEK—SUNDAY.

REGENERATION.

Spring is the season when all the operations which tend to reproduction, are carried on. Mysteriously, and far beyond human ken, is the sap rising in the plant, the bone grow-

ing in the womb, and the pulpy matter of the egg assuming the more solid form of nerves, sinews, bones, and even feathers. The eye of inexperience, on examining these first rudiments of organized matter, could, by no skill or ingenuity, imagine the result of the perfected work. A confused gelatinous mass, with a dark speck in the centre, or, at a more advanced stage, a few dark thready-like lines, would little suggest the form of the creature, instinct with animation, and buoyant with the joy of life. We know not 'the works of God, who maketh all,'—we can only admire and adore. But there is a greater, a more mysterious work, and one higher in its aim, continually in progress. I mean, the hidden work of the Holy Spirit upon the spirits of human beings. It is higher in its aim, because it is not the formation of an organized, and material, and perishable creature, which fulfils its functions for a time, and then returns to its parent earth; but the formation of a spiritual and imperishable being, that must return, in a holy and perfect state, to the God who gave it birth. Well may any man, in the darkness of the carnal character, say with Nicodemus, 'How can these things be?' How can that which has unresistingly obeyed the law of the members, turn itself to the obedience of a holy and spiritual law? How can the servant of sin become sin's master? How can he, who has found the Sabbath a weariness, and, if he ever tried spiritual prayer and praise, has discovered them to be impracticable exercises for him, join with a joyful heart in those holy occupations, which prepare God's own children for the inheritance of the saints in light? How can these things be? Wonderful transformation!—Unseen, mysterious, but growing apace; strengthening and expanding as it grows, and as certainly bringing forth new volitions and new exercises, as the living thing that is formed in the shell, will, when it comes forth, perform all the functions of life.

The first approaches to life are generally feeble and nearly imperceptible; and it is not till they have acquired a degree of strength, that we really ascertain life to be there. So, frequently in a Christian land, and especially with those who

have been nurtured in Christian families, the first tokens of spiritual life are dubious and faint. Those who have experienced the blessed change, and have attained to something of the statute of perfect men in Christ Jesus, recall the first pang of conscience upon some known transgression, painful and pungent for a while, and then dying away, and leaving no important trace. The first careful thought of the broad way leading to destruction, and the narrow way leading to life, producing, peradventure, some anxiety and some resolutions against sin; the first affliction, or anticipated affliction, exciting the dread of bereavement, and the consciousness of dependance, and leading to the Hearer of Prayer, is something better than the mere formal temper in which past prayers have been employed. These feeble tokens may be quenched in their first struggle for existence, or they may be cherished into life and strength. O, beware how you treat them. Feeble though they be, they are the work of the Spirit.—They have the germ of immortality in them. Destroy them not, for a blessing is in them. Rejoice on account of them, they come from God; they contain the rudiments of an immortal intelligence, they are the embryo of an heir of glory. On you, who experience them, lies the obligation to endeavour to quicken their growth, and to speed their extension over the whole of your character.

Your *will* must be new in all its features. Naturally it was headstrong, resolved to have its way, running blindly headlong to perpetrate its purposes. Saul thought it his duty to torment the church of Christ. He rushed on from zeal to greater zeal, from afflicting the saints at Jerusalem, to pursuing them to a distant city; and, not content with taking the leaders as his mark, the feeble women were not exempted from bonds and imprisonments. His will seemed invincible. But, behold the man, convinced that the Jesus whom he persecuted is both Lord and Christ, and what is the result? His will is subdued,—it is become pliant,—it is waiting and longing for guidance,—'Lord, what wilt thou have me to do?'

Your *affections* must be all made new. Matthew, the tax-

gatherer, left the receipt of custom, gave up the occupation by which he had his living, to follow after him whom he learned to love as his Guide and Redeemer. Zaccheus, whose wealth had been obtained by extortion, not only foregoes dishonest gains, but restores fourfold what he had taken unjustly Nay, more, his mind is so humbled, that he owns to Jesus, in the hearing of many, that it has been his habit to take unjustly. Here is a complete overturn in the whole man. The world is no longer the keen object of his pursuit. He has become liberal to those whom it was his gratification and earnest desire to rob in time past; and, in addition to this, he feels so sure that he hates the ways he once delighted in, that he draws near to his Saviour, with confession of past sin, and the expression of resolutions for the time to come. Here are new affections, indeed. Have we experienced them? Are we ready to sacrifice the earthly things, the corrupting things, the vain things, which have occupied our lives, and formed our business and delights, that we may devote ourselves to the Holy One, who sacrificed himself for us?—Or rather, do we feel it no sacrifice? Would it be our punishment now to pursue these things? Are we sensible that our hopes, our fears, our joys, are changed? Then, whether the process has been slow and gradual, or whether it has been by instantaneous and overpowering conviction, the change is wrought, the new creature is formed, and that new formation is the work of the Spirit of God.

Say not that you are not renewed in the spirit of your mind, because you do not feel the change perfect. Since man, in his fallen state, is but a ruin, and what has been thrown down must be repaired, be not surprised if it is not a perfect work at once. The change can be and must be complete, though it be not perfect. You must be renewed in the *whole* man, though the whole man still go halting, by reason of the fall. The babe does not learn to go alone in a day or a year, yet every day approximates to that period of its advancing strength. Only ascertain that it possesses real life and health, and be assured that it will advance till it attain maturity. 'One

stroke of the chisel does not make a statue;' neither does one pang of contrition, one good resolution, or one prayer, make a child of God. But the Lord himself is engaged on the side of those who seek to turn to him. He has told us of the heavenly temple, whose stones are polished, and fitly joined together, he himself forming the chief corner stone. Put your case, then, into his hands. It is his care and concern, with which yours now co-operate, that must finish the work. Repeated and renewed strokes of the chisel may be requisite; he is faithful, he will not withhold them. If you be still unconquered in will, he can vanquish you by some soul-subduing affliction; and he will do this, if your perverseness forces him to it. If your affections be still unweaned or unpurified, he can destroy the objects in which they centre, or take away, with a stroke, the creature that draws your spirit earthward; and this his faithfulness constrains him to do, rather than that the birth of your soul should be rendered abortive. Say not, then, 'How can these things be?' but ask of Him, for whom 'nothing is too hard,' to form in you that new creature, without which nothing else availeth you. He who caused your bones to grow at first, without any leave asked of you, will not fail to complete the weighty concern of forming you anew, after his own image. And though the work may be hid for a time from all bystanders, and though you may occasionally be unable to discriminate the natural motions of conscience, and the accumulating light of your own understanding, from the emotions and helps of the life-giving Spirit, yet fail not to go forward. He knoweth his own work, and will recognize it; and the fruits of the Spirit will presently be manifest to those around you, while they are filling the hidden man of your own heart with love, joy, and peace.

But, says some reader, I do not know—I cannot learn whether this mysterious work is begun in me or not. It is an occult concern, it seems, as little to be observed as the growth of the chick in the egg,—how then can I observe it? True! you, who dwell on the outside of the shell, discern not the process

within; you see not what is in the bosom of your neighbour; but have you ever tried to examine what is in your own? There is one discerning eye that observes it all, and perhaps at this moment remarks your difficulty, as but a cavil raised up for an excuse. Well, I will give you one test by which you may try whether this mysterious work is begun in you or not. God desires his children to be 'ever' with him. He has made arrangements, which will enable them to learn the song of Moses and the Lamb, and to unite themselves with the blessed throng who give glory to his name for ever. And, preparatory to these employments, he teaches them to be fervent in prayer and supplication; to unite their hearts in thanksgiving and praise. Can you do this? *Try it.* This is my test. If you cannot find food for prayer in this world of many necessities, how shall you find employment for praise, in a region where necessity, and want, and pain, and fear, have no existence? If you do not enough adore redeeming mercy, to give thanks for it here,—if your heart cannot commune with God for half an hour in this state, would his eternal presence and unceasing communion be less than intolerable to you in that country, where all behold, and enjoy, and adore? This test is simple, and it is infallible. O do not turn from it, till you have tried it. Haply, it may be the means by which Divine grace shall cause the first pulse of spiritual life to awake in your heart.

M. G. L. D.

SIXTH WEEK—MONDAY.

BIRDS.—RELATION OF THEIR BODIES TO EXTERNAL NATURE.

THE evolution of the chick in the egg, may be taken as an example of the earliest processes of animal organization in general, because, such is the analogy of nature, that the *plan* by which the embryo of all the higher species of animals is developed, whether in the egg or in the womb, is nearly the

same. But there are certain peculiarities in the form and modifications of the bodies of birds, intended to suit them for the element in which they are destined to move, very striking as indications of design, to which, before leaving the subject of organization, it is desirable to advert. I take the general scope of the argument from Paley, with the illustrative observations of Sir Charles Bell.

Birds are intended for the very peculiar function of raising themselves above the earth, and transporting themselves from place to place, through the air; an achievement which must appear, at the very first glance, to require a peculiar conformation of body. We are familiar with this action of birds, and are therefore apt to pass it over without much observation; but if any one divesting himself of his previous knowledge, could sit down to try, without the aid of experience, how the matter could be managed, he would soon find that the problem was by no means an easy one. The first thing which would strike him, would be the difficulty of causing a body, specifically heavier than the atmosphere, to float in that element. If this were overcome by the aid of dynamics, he would immediately find other questions arising, for an answer to which, that science must also be appealed to; the means of equipoise and voluntary progression, the best mechanical contrivances, at once for lightness, and for strength of structure, the forces most skilfully adapted for cutting the air, for passing through it with pleasure in all directions, for resisting the current of the wind, and flying against it; the most advantageous conformations of the external covering of the body; the shape of the wings best calculated for soaring, for rapid flight, for alighting, for fitting gracefully and easily to the body, when at rest,—all these, and a thousand other inquiries would occur to him, involving the laws both of solids and of fluids, till he would find himself lost in the intricacies of the subject, and be forced to confess that he who could conquer all its difficulties, must, to say the very least, be possessed of no ordinary accomplishments. Now, all these questions have certainly been considered, and solved in

forming the body of a bird, with relation to its aerial functions. Let us look at a few of them.

The first query is, How a creature, which has to exercise the same animal functions as quadrupeds, shall be able to rise into the air. Contrivances must, of course, be resorted to, for rendering its body as light as is consistent with other conditions. What has actually been done with this view? In the first place, the body of the bird has been enlarged, without increasing the weight in nearly the same proportion. The windpipe of the swan and crane is adduced by Sir Charles Bell, as an instance of this; and he has given a drawing illustrative of the curious convolutions which this member undergoes, within the sternum or breast-bone of the bird. 'The light and hollow air-tube fills a space in the interior of the bone, by which the surfaces are extended for the attachment of the muscles of the wings, and thus two objects are attained through it.'*

But there is a still more curious provision for the extension and magnitude of the body of the bird, independently of weight. In birds, the air does not only pass *into* their lungs, but *through* them, so as to fill a series of air-cells, composed of fine membranes, which are interwoven with all the intestines. The heart is surrounded with such a cell. Two great cells are attached to the liver; and in the same manner, are all the viscera of the abdomen interspersed with air-cells, and these all communicate. The air, thus admitted into the interior of the body, extends even into the bones.

'In comparing the bones of animals,' says Paley, 'we are struck, in the bones of birds, with a *propriety*, which could only proceed from the wisdom of an Intelligent and Designing Creator. In the bones of an animal that is to fly, the two qualities required are strength and lightness. Wherein, therefore, do the bones of birds (I speak of the cylindrical bones) differ in those respects from the bones of quadrupeds? In three properties; first, their cavities are much larger, in

* Appendix to Paley's Natural Theology, Knight's edition, vol. ii. p. 279.

proportion to the weight of the bone, than in those of quadrupeds; secondly, these cavities are empty; thirdly, the shell is of a firmer texture than in the substance of other bones. It is easy to observe these particulars, even in picking the wing or the leg of a chicken. Now, the weight being the same, the diameter, it is evident, will be greater in a hollow bone than in a solid one, and with the diameter, as every mathematician can prove, is increased, *cæteris paribus*, the strength of the cylinder, or its resistance to breaking. In a word, a bone of the *same weight* would not have been so strong in any other form; and to have made it heavier, would have incommoded the animal's flight.'*

Connected with the subject of weight, is the contrivance of making birds *oviparous*, by which means the important work of gestation goes on with as little increase as possible of the weight of the body. It is well known, that birds of prey sometimes gorge themselves to such excess, that they are unable to rise on the wing, a proof that the burden of offspring in the womb, would have been unsuitable to the purposes of flight. The advantage, in this respect, of an oviparous procreation is, that, while the whole brood is hatched together, the eggs are produced singly, and at considerable intervals.

Paley draws an argument for design, by comparing animals with regard to their *instruments of motion;* and here also the contrivances which fit the bird for its peculiar motions, are very admirable and peculiar. In comparing feet, wings, and fins, he exclaims, 'I desire any man to say which of the three is best fitted for its use, or whether the same consummate art be not conspicuous in them all.'

After noticing the striking analogy which subsists between a wing and the fore-leg of a quadruped, he goes on to say:— 'Fitted up with its furniture of feathers and quills, it becomes a wonderful instrument, more artificial than its first appearance indicates, though that be very striking. At least the use which the bird makes in flying, is more complicated and more curious than is generally known. One thing is certain, that

* Paley's Natural Theology, Knight's edition, vol. ii. p. 277.

if the flapping of the wings, in flight, were no more than the reciprocal motion of the same surface, in opposite directions, either upwards or downwards, or estimated in any oblique line, the bird would lose as much by the one motion as she gained by the other. The sky-lark could never ascend by such a motion as this; for, though the stroke upon the air, by the underside of the wing, would carry her up, the stroke from the upper side, when she raised her wing again, would bring her down.' Having started this difficulty, our author proceeds, by a description of the form of the wing, and the action of the muscles and joints of the pinions, to show how successfully it is obviated, and how distinctly there are exhibited, in this mechanism, evidences of skilful contrivance. He then speaks of the tail as an instrument of steerage, and adds, 'Herein we meet with a circumstance not a little remarkable. Birds with long wings have short tails; and, in their flight, place their legs close to their bodies, at the same time stretching them backward as far as they can. In this position, the legs extend beyond the rump, and become the rudder, supplying that steerage which the tail could not.'*

In another part of his work, Paley gives his celebrated description of a feather, in which he demonstrates that it is, for strength, lightness, elasticity, and resistance to the air, what he happily calls a mechanical wonder. I must not occupy so much room as would be necessary for doing justice to this admirable analysis; and shall conclude with the animated observations with which he introduces it. 'The covering of birds cannot escape the most vulgar observation: its lightness, its smoothness, its warmth,—the disposition of the feathers, all incline backward, the down about their stem, the overlapping of their tips, their different configuration in different parts, not to mention the variety of their colours, constitute a vestment for the body, so beautiful and so appropriate to the life which the animal has to lead, as that, I think, we could

* Paley's Natural Theology, Knight's edition, vol. i. pp. 280, 281. See this subject further discussed in 'Summer,'—paper on 'The Power of Flying.'

have had no conception of any thing equally perfect, if we had never seen it, or can now imagine any thing more so. Let us suppose (what is possible only in supposition) a person who had never seen a bird, to be presented with a plucked pheasant, and bid to set his wits to work, how to contrive for it a covering, which shall unite the qualities of warmth, levity, and least resistance to the air, and the highest degree of each; giving it also as much of beauty and ornament as he could afford:—He is the person to behold the work of the Deity in this part of His creation, with the sentiments which are due to it.'*

SIXTH WEEK—TUESDAY.

BIRDS.—THEIR REPRODUCTIVE INSTINCTS.—PAIRING.

THE instincts of birds intended to give efficacy to that great object, the preserving of successive generations of the species, are not less admirable than the organic mechanism which has been described, as constructed with the same design. The first of these instincts, in the order of time, is that which leads birds to pair.

Early in spring, almost every little songster of the grove is found to have chosen a mate, to which he remains faithful, till the young brood,—the offspring of their mutual loves, and the object of their tender cares,—have become able to provide for their own subsistence. In this respect, they approach nearer the human race than any other of the lower animals. Male insects, so far as we know, never share in the parental cares of the female. In some few instances of insects living in communities, these domestic duties are performed by a separate caste, as we have already seen in the case of bees and ants; in all other instances, the task seems to fall exclusively on the female.

The males of quadrupeds are, in the greatest variety of

* Paley's Natural Theology, Knight's edition, vol. i. p. 250.

cases, not more observant of the wants of their future off spring than those of insects; though there are considerable exceptions to this rule, among those classes of the brute creation which burrow in the earth, or whose progeny are long helpless and dependant. This matter, indeed, is regulated like every other provision of Creative Intelligence, with singular adaptation to the wants and circumstances of the species. Where animals suckle their young, as is the case with quadrupeds, the attentions of the male are seldom required, the necessary food being at hand; and, in the case of insects, the eggs are usually deposited where the larvæ, as soon as hatched, can easily find their way to their own food, so that, in many instances, the egg is abandoned, even by the female, the moment it is dropped; and, where incubation takes place, as in the case of the spider, the first appearance of a living progeny is a signal that her task is at an end.

It is not so with birds. Their parental duties are tedious and full of labour, beginning long before the chick is produced, and continuing for a considerable time after its extrusion from the shell. They have frequently to build an artificial nest, with skill and toil, after which the eggs are to be laid and brooded on, the young are to be fed and educated. All of these operations require, some of them absolutely demand, the mutual labours of the parents. The feeding of the young, for example, might, in many instances, be impossible, without the efforts of both the male and the female. A young bird, in the nest, is exceedingly voracious, and will eagerly consume its own weight of food in a day. Where the means of procuring a daily supply for eight or ten greedy and craving mouths, is not very near or abundant, it is easy to see that the poor mother could not, with all her care, accomplish the task alone. The Creator, therefore, who placed her in these circumstances, has provided for her the means of not only lightening her labours, but rendering them delightful. Her faithful and affectionate mate constantly attends her; they build the nest together; by day, while she performs the duty of incubation, he either collects her necessary food, and care-

fully feeds her himself, or occasionally supplies her place in the nest, while she hunts the hedges and fields, to satisfy her own wants; and, when the task is accomplished, he sits on a neighbouring bough, and cheers her tedium with a song. By night, the nest is their common roosting-place, where they nestle side by side. When the callow brood are hatched, they roam, together or apart, to forage for them in the neighbouring gardens, or woods, or lawns; and, urged by parental affection, and warmed by mutual sympathy, they ply their constant toil, without remission, and without weariness. When, at length, the first helpless stage of existence is past, and the young, full-fledged, are to be committed to their own resources, the little patient and affectionate arts with which they unite to train their tender charge to the important functions of their being, gracefully crown these varied labours of love.

That reciprocal affection is the moving principle of these instincts, is not only probable, from their analogy to human sympathies, but seems to be proved by various facts, which have been observed by those who have studied their habits. On this subject, I have been much struck with a well-told and interesting anecdote, by Bingley, of a pair of tame Guinea parrots, which I feel much pleasure in transcribing.

'A male and female of this species were lodged together in a large square cage. The vessel which held their food was placed at the bottom. The male usually sat on the same perch with the female, and close beside her. Whenever one descended for food, the other always followed; and when their hunger was satisfied, they returned together to the highest perch of the cage. They passed four years together in this state of confinement; and, from their mutual attentions and satisfaction, it was evident that a strong affection for each other had been excited. At the end of this period, the female fell into a state of languor, which had every symptom of old age; her legs swelled, and knots appeared upon them, as if the disease had been of the nature of gout. It was no longer possible for her to descend and take her food, as formerly; but the male assiduously brought it to her, carrying it in his

bill, and delivering it into hers. He continued to feed her in this manner with the utmost vigilance, for four months. The infirmities of his mate, however, increased every day; and at length she became no longer able to sit upon the perch; she remained crouched at the bottom, and, from time to time, made a few useless efforts to regain the lower perch; while the male, who remained close to her, seconded these feeble attempts with all his power. Sometimes he seized with his bill the upper part of her wing, to try to draw her up to him; sometimes he took hold of her bill, and attempted to raise her up, repeating his efforts for that purpose several times. His countenance, his gestures, his continual solicitude, every thing, in short, indicated, in this affectionate bird, an ardent desire to aid the weakness of his companion, and to alleviate her sufferings. But the scene became still more interesting, when the female was at the point of expiring. Her unfortunate partner went round and round her without ceasing; he redoubled his assiduities and his tender cares; he attempted to open her bill, in order to give her nourishment; his emotion every instant increased; he went to her, and returned with the most agitated air, and with the utmost inquietude; at intervals he uttered the most plaintive cries; at other times, with his eyes fixed upon her, he preserved a sorrowful silence. His faithful companion at last expired; he languished from that time, and survived her only a few months.'*

SIXTH WEEK—WEDNESDAY.

BIRDS.—THEIR REPRODUCTIVE INSTINCTS.—PAIRING CONTINUED.

THE affectionate attention which birds show to each other during the pairing season, and in some instances continue to evince at other times, was noticed yesterday. Some other instances of this, marking peculiarities in the instinctive feeling, shall now be mentioned.

* Bingley's Animal Biography, vol. ii. p. 224.

Birds which are constant to each other, as there is reason to believe many species are, generally return to the same locality in the breeding season, and if they are not migratory, remain throughout the year in the immediate neighbourhood. 'We have, in more than one instance,' says Mr. Rennie, 'observed a pair of magpies nestle on the same tree for a series of years, where they reared a brood of four or five young ones every season All of these disappeared from the neighbourhood; at least we observed no increase in the number of nests. In one instance we observed a magpie's nest thus successively occupied for ten years.'*

It is well known, that migratory birds return year after year to the same place, each accompanied with his mate; it is not certain, however, whether or not the mate be the same individual; and, indeed, the facility with which a bird which has lost his companion can supply himself with another, throws some doubt on the subject. This facility is mentioned both by Montague and White, who have stated various facts in support of it. The following anecdote, recorded by Professor Kalm, is very striking. 'A couple of swallows built their nest in a stable, and the female had eggs in the nest, and was about to brood them. Some days afterwards the people saw the female sitting on the eggs; but the male flying about the nest, and sometimes sitting on a nail, was heard to utter a very plaintive note, which betrayed his uneasiness. On a nearer examination, the female was found dead in the nest, and the people flung her body away. The male then went to sit upon the eggs; but, after being about two hours on them, and, perhaps, finding the business too troublesome, he went out, and returned in the afternoon with another female, which sat upon the nest, and afterwards fed the young ones till they were able to provide for themselves.'

Mr. Rennie mentions some circumstances respecting the black-cap, which seem to confirm what has been stated above, and are curious in themselves. 'There has been,' says he, 'in a garden adjacent to ours, the nest of a black-cap for a

* Library of Entertaining Knowledge.—Habits of Birds, p. 74.

succession of years, and broods have been successively reared there, without any observable increase in the population of the species. Yet this bird, which is little bigger than a wren, weighing only half an ounce, has to traverse annually the whole of the south of Europe, and probably a great proportion of the north of Africa, exposed, of course, to numerous accidents, as well as to occasional scarcity of its appropriate food. From the regular annual restoration, however, of this nest at the same spot, it is obvious, that one, if not both of the black-caps, must have been wont to perform this migration to and from Africa, as safely as the more hardy cuckoo, or the more swift-winged swallow. During the spring of 1831, the black-caps, which we suppose to be the same birds, from their keeping to the same place of nestling, were more than usually late in arriving; for, in another garden, about a mile off, there were young in the hereditary nest of black-caps, before our little neighbours made their appearance from the south. When they did arrive, their attention was immediately attracted by the unusual circumstance of hearing the loud song of a rival, in the vicinity of their premises. This was a cock black-cap, which we had purchased the preceding autumn in the bird-market at Paris, and which we daily hung out in his cage, to enjoy the fresh air and the sunshine, within a gun-shot of their usual place of nestling. The wild birds did not appear to like the little stranger at all; and the cock kept flying around the cage, alternately exhibiting curiosity, fear, anger, defiance, and triumphant exultation. Sometimes he would flit from branch to branch of the nearest trees, silently peeping into the cage with the utmost eagerness; all at once, he would dart off to a great distance, as if afraid that he was about to be similarly imprisoned; on getting the better of his fears, he would perch on a conspicuous bough and snap his bill, calling *cheek, cheek*, seemingly in a great passion; again he would sing his loudest notes by way of challenge, or perhaps meaning to express his independence and superiority. Our cage-bird, meanwhile, was by no means a passive spectator of all this; and never failed, on the appearance of the

other, to give voice to his best song, and to endeavour to outsing him, since he could not get at him to engage in personal conflict.

'This sort of altercation continued for more than a week, but the wild bird began gradually to be less eager to pry into the cage, or to take any other notice of the cage-bird, and at length ceased altogether to approach it, his attention being now wholly occupied in attending to his mate, and aiding her in building their nest. It is worthy of remark, that though, on their first appearance, they resorted to the garden where the nest had hitherto been built, they finally fixed their residence in another garden, at some distance, induced, no doubt, by the vicinity of our cage-bird to their former haunts. The distance of the place to which they removed is such, that we can readily hear the song of the cock, and our bird is no less eager to answer and to endeavour to outsing him than at first; while it is worthy of remark, that the wild bird is no longer interested in such rivalry, and sings as if his only concern was to please himself and his mate.'*

Mr. Rennie is of opinion, that it was the dread of a successful rival which led the wild bird to manifest such varied expressions of passion, and hence he concludes, that, had he been removed, the hen would have readily paired with the tame bird, which is by no means improbable. But whatever there may be in this, instances of great attachment between mates are familiar, and render these little tenants of the grove peculiarly interesting.

The feeble attempt of the swallow, to supply the place of his dead mate, by brooding on the eggs, reminds me of a fact which came under my own eye, and which proves that a similar propensity sometimes exists among male birds, in a far stronger degree. One of my neighbours and parishioners had a turkey-cock and hen, which were carefully fed, and while the latter was sitting on her eggs, the former exhibited a great desire to imitate the example of his mate. He prepared a nest for himself, and sat patiently on it for several days, with-

* Library of Entertaining Knowledge.—Habits of Birds, pp. 75–77.

out eggs; and when he was chased from it, and the materials of his nest were removed, he showed great uneasiness, until he had found another situation favourable for his purpose, where he again took his seat with unshaken perseverance. At last his wishes were gratified, by being supplied with eggs, to the amount of twenty-seven, of which a few were hen eggs. The cock carefully brooded on these eggs till they were hatched, not one of them failing to be productive. To these a brood of ten chickens, brought out by a hen at the same time, was added, and he nursed the whole brood of thirty-seven without losing one. He showed, indeed, the greatest solicitude for the welfare of the young, tending them with remarkable care, and taking upon him all the duties which, in the usual course of things, fall exclusively to the mother's share. Next year, when the hen had laid her complement of eggs for a new brood, and was in the act of incubation, the cock, finding himself left alone, set himself affectionately down by the side of his mate, and could not be induced to leave her, except for necessary food. His nest was again supplied with eggs, and never did a hen fulfil her tedious weeks of incubation with greater assiduity or skill. I witnessed the fond pair on their respective nests. They were situated very near, but not in actual contact, and their faces being turned towards each other, they seemed to regard one another with a tenderness at once interesting and pleasing. This remarkable pair hatched each its own brood, and attended them as long as they required their care, with fidelity and success.

The facts I have related are the more singular, as they seem contrary to the usual instincts and habits of the turkey, especially in a wild state.* Audubon and Charles Bonaparte give an account of the wild turkeys of America, from which it appears that they only pair during the breeding season; that the cock endeavours to break the eggs of the hen, which induces her carefully to conceal her nest from him; and that,

* Pliny, however, mentions instances of cocks rearing the brood when the hen happened to die, and cases of the turkey-cock sitting on a brood have been observed by others.

at other seasons, the males and females associate and feed in companies apart, the latter and their broods carefully avoiding the haunts of the former, that they may escape fatal consequences from their hostility to their young. It is singular to observe this change of instinct, arising from altered circumstances. The absence of a rival probably contributed to give so different a character to the manners of the cock I have mentioned..

The pairing instincts now detailed, are not without considerable exceptions, among which, one of the most remarkable, is the polygamous habits of most birds. Of this kind, we have a well-known example in the domestic cock; but, as my plan leads me rather to draw a sketch than write a history, what I have already said on this subject may suffice. The reader will not fail to recognize, even in these hasty details, unequivocal traces of Divine skill, of which here, as in every other department of Nature, the whole works of the Creator are full.

SIXTH WEEK—THURSDAY.

REPRODUCTION OF BIRDS.—NEST-BUILDING.

The first care of birds, after pairing, is to discover a fit place for preparing their nests; and, in doing this, their instincts, which are uniform in the species, direct them with admirable tact to the locality best suited for their own peculiar habits and temperament, as well as for the purposes of concealment from their enemies, or at least of safety from their attacks. If there are exceptions from this rule, they are such as serve only to confirm it, by showing more clearly its nature and beneficent object. The ostrich, for example, which resides in the desert wilds of Africa, apart from the habitations of her enemy man, and also, in general, from any animal likely to annoy, which can cope with her in strength, lays her eggs in a nest carelessly chosen, and very inartificially formed, in the

bare sand; but then, these nests are never deserted, for the male alternates the act of incubation with the female. The eagle builds his eyrie among the almost inaccessible rocks of the lofty mountains, open to the atmosphere, but secure. The smaller birds, whether they construct their nests among the long grass of the meadow, the bush or brake of the woodlands, the leafy hedge or lofty bough, or whether they seek the dwellings of the human race, and nestle in the window-corner, in the eaves of the thatched roof, or in the shelter of some deserted chimney, uniformly display a consummate skill in acting on the principle I have stated, so far as is consistent with other circumstances in their condition and habits.

But what is still more worthy of remark, is the degree of care with which the nest itself is constructed, which remarkably corresponds with the necessity of the case. I have mentioned the carelessness with which the eagle and the ostrich prepare their nests; and this inattentive habit is common to almost all the larger birds, while, in proportion as the size of the bird diminishes, the skill with which the materials of the nest are selected and interwoven is in general increased. The intention of this is not doubtful. The chief object of careful nest-building, is the preservation of an equable heat in the eggs; but when the fowl happens to be large in proportion to the size or number of the eggs, or when the temperature of the climate is warm, the natural heat of the body is sufficient for all the purposes of incubation; and it is only when this circumstance is reversed, as is the case in the smaller birds, or in such as build in a cold climate, or early in spring, that any artificial means are necessary. There is here, then, a remarkable accommodation to circumstances—a wisdom altogether beyond that of the bird itself, and referable, like other instincts, only to the Creator. Who taught those early breeders, the blackbird and the thrush, to plaster their nests with loam, that they may exclude the keen icy gales of the still lingering winter? Who taught the eider-duck, in the chilly regions of Iceland, to tear the down from her body, that by a lining so soft and warm, she may protect her precious

charge from the inclemency of that climate? Who taught that hardy little warbler, the golden-crested wren, which fears no cold for itself, and which delays its maternal labours till the middle of summer, to compensate for the trifling degree of warmth communicated from its tiny form, by building its beautiful nest, of the warm and velvet moss, interwoven with the spider's web, and filled with such a profusion of feathers, that its little eggs, by the retention and accumulation of the heat, are kept in a temperature at once high and equable? And, on the other hand, who taught the emu, the osprey, and the condor, to know that their comparatively gigantic bodies were sufficient of themselves, without the aid of an artfully formed nest, to impart the requisite warmth for the vivifying of their eggs, small as they are in number, and large in bulk?* Who, indeed, we may ask, taught any of the winged tribes that the heat of their bodies was necessary for the development of the embryo in the egg? The whole subject is full of wonder and instruction, and calculated to overwhelm the mind with devout admiration. 'Who knoweth not, in all these, that the hand of the Lord hath wrought this?'

Another circumstance which I may mention, is the remarkable variety observable in the habits of birds in nest-building, where the instinct itself is so peculiar, and its general principle so identical. The same form of the nest, and place of building, and materials employed, are rarely, if ever, found united in the architecture of different species; and, indeed,

* It must be confessed, however, that although what has been said in the text is true as a general law, there are many instances for which it may be difficult to account on the same principle, though, doubtless, even these cases, were we acquainted with all the circumstances, would be equal indications of wise adaptation. The wood-pigeon and the jay, for example, though they erect their fabrics on the tall underwood, in the open air, construct them so slightly, and with such a scanty provision of materials, that they seem scarcely to make sufficient provision for the supply of the brood, and even their eggs may almost be seen through the loosely connected materials. Is it, that there is something in the constitution of the eggs, which makes them less susceptible than others of the alternation of heat and cold?

in every one of these particulars, there is generally some specific difference. The house-sparrow builds four or five times in the year, in a variety of situations, under the warm eaves of our houses and sheds, the branch of a clustered fir, or the thick tall hedge which bounds our garden, employing, in all these situations, a mass of straw and hay, and for a lining feathers from the poultry-yard. The goldfinch forms the cradle of its young with fine mosses and lichens, collected from the apple or pear-tree, compact as felt, lining it with the thistle-down,—a model of beautiful construction. A few loose bents and goose-grass, on the other hand, rudely entwined, with perhaps a sprinkling of hair, suffice for the midsummer nests of the whitethroat and blackcap. The greenfinch builds carelessly in the hedge, with materials of the coarsest kind; while the chaffinch constructs its anxiously-concealed edifice with the nicest art, in the neighbouring beech or elm. The bullfinch requires fine roots for its nest; the grey fly-catcher chooses cobwebs for the out-works of its building.* It seems as if Providence had intended that all kinds of portable materials, adapted for the purpose, should be put in requisition by this variety of choice in the different families, so that nothing might be lost, and that one species might not inconveniently interfere with another.

'It wins my admiration
To view the structure of that little work—
A bird's nest. Mark it well, within, without;—
No tool had he that wrought; no knife to cut;
No nail to fix; no bodkin to insert;
No glue to join; his little beak was all;
And yet, how neatly finished! What nice hand,
With every implement and means of art,
And twenty years' apprenticeship to boot,
Could make me such another? Fondly, then,
We boast of excellence, whose noblest skill
Instinctive genius shames.'—HURDIS.

* Journal of a Naturalist.

SIXTH WEEK—FRIDAY.

REPRODUCTION OF BIRDS.—NEST-BUILDING CONTINUED.

In yesterday's paper, having made some general observations relative to the instincts connected with nest-building, I shall, to-day, select a few instances of peculiarity in this species of architecture, which may serve to illustrate these remarks.

I begin with the eagle, which has justly been termed the king of birds. Her nest is usually built, as I have already observed, in some inaccessible cliff of a rock; sometimes shielded from the weather by an overhanging crag, but sometimes also exposed both to the wind and rain. It is flat, though built with considerable labour, and the pains bestowed in erecting it seem only once to be encountered, as she is said to make it her breeding-station for life. Willoughby thus describes a nest which was found on the Peak of Derby:—'It was made of great sticks, resting one end on the edge of a rock, the other on two birch trees. Upon these was a layer of rushes, and over them a layer of heath, and upon the heath rushes again; upon which lay one young one, and an addle egg; and, by them, a lamb, a hare, and three heath plants. The nest was about two yards square, and had no hollow in it. The young eagle was of the shape of a goshawk, of almost the weight of a goose, rough-footed, or feathered down to the foot, having a white ring about the tail.'

The circumstance mentioned of the addle egg, seems to be very common among all the eagle tribes, owing, perhaps, to the flatness of the nest; and, it may be regarded as indicating the same providential intention as that already alluded to in regard to the fewness of their eggs. The design is, that this devourer of the more helpless of the quadruped tribes, should be preserved and propagated in sufficient abundance to perform its office of keeping these prolific species within their proper bounds, but should, at the same time, be prevented from itself becoming a pest by over production.

The woodpecker is another bird whose nest is an object of curiosity and admiration, though for a very different reason. This numerous tribe have very remarkable habits in procuring their food: and the instruments with which they are endowed, are admirably fitted to the peculiarity of their condition, which consists in feeding on insects lodged in the interior of decaying trees. These I must not stop at present to describe; but I have to observe that its bill, which is so beautifully contrived for procuring its subsistence, serves also, in this country, to enable it to scoop out for itself a nest, which it does with all the neatness of an experienced workman, in one of the trees where it finds its food. The work is thus graphically described by Wilson:—'About the middle of May, the male and female look out for a suitable place for the reception of their eggs and young. An apple, pear, or cherry-tree, often in the near neighbourhood of a farm-house, is generally pitched upon for this purpose. The tree is minutely reconnoitred for several days previous to the operation; and the work is first begun by the male, who cuts out a hole in the solid wood, as circular as if described by a pair of compasses. He is occasionally relieved by the female,—both parties working with the most indefatigable diligence. The direction of the hole, if made in the body of the tree, is generally downwards, by an angle of thirty or forty degrees, for the distance of six or eight inches, and then straight down, for ten or twelve more, —within, roomy, capacious, and as smooth as if polished by the cabinet-maker; but the entrance is judiciously left just so large as to admit the bodies of the owners. During this labour, they regularly carry out the chips, often strewing them at a distance, to prevent suspicion. This operation sometimes occupies the chief part of the week.'

This labour is sufficiently curious; but what is far more worthy of attention, is the total change of instinct in birds of the same species, under other circumstances. There is not, indeed, in the whole history of Nature, a more singular instance of sagacity, if it can be called by that name, than what is displayed by these little winged wonders, in protecting

themselves against their enemies. In civilized countries, man is the chief foe they have to dread; and the nest we have described suffices for their protection from him. But the case is different in the wide-spread forests of America. In the depth of these wildernesses, where little is to be apprehended from man, it is not concealment that is necessary, but a situation beyond the reach of those rapacious creatures which infest the woods, and live by plunder. From the monkey and the snake, which are in these regions the natural enemies of the woodpecker, its European nest would be no security. It must select a place which these insidious foes may, indeed, observe, but cannot invade. This, with admirable skill, it accomplishes, by building its nest depending from the most outward branches of a tall tree, such as the banana or the plantain. 'On one of these immense trees,' says Goldsmith, 'is seen the most various and the most inimical assemblage of creatures, that can be imagined. The top is inhabited by monkeys of some particular tribe, that drive off all others; lower down, twine about the great trunk, numbers of the larger snakes, patiently waiting till some unwary animal come within the sphere of their activity; and, at the edges of this tree, hang those artificial nests, in great abundance, inhabited by birds of the most delightful plumage.'

The nest is usually formed in this manner:—When the time of incubation approaches, the woodpeckers fly busily about, in quest of a kind of moss, called, by the English inhabitants of those countries, *old-man's-beard*. It is a fibrous substance, which bears to be moulded into any form, and glued together. This the little bird first fixes, by some viscous substance, gathered in the forest, to the most extreme branch of a tree; then, building downwards, and still adding fresh materials to those already procured, it forms a nest, which hangs, like a pouch, from the point of the branch. The hole to enter at is on the side; and all the interior parts are lined with the finer fibres of the same substance, which compose the rest of the fabric.

Such is the ingenious and effectual contrivance, by which

the American woodpeckers, as well as some other birds who have the same enemies to dread, save themselves and their young from the depredations of the serpent and the monkey. The nest hangs there, before the spoilers, a tempting object, which they can only gaze upon, while the bird flies in and out, without danger or molestation.

This instinct is common to many tribes of birds. Some form their pensile nests in the shape of a purse, deep and open at the top; others with a hole in the side; and others, still more cautious, with an entrance at the very bottom. But of them all, the tailor-bird shows the greatest diffidence, advancing a step farther for safety, by fixing its light nest on a leaf. It picks up a dead leaf, and actually sews it to the side of a living one, its slender bill being its needle, its thread some fine fibres, and the lining, feathers, gossamer, and down. Its weight is only three-sixteenths of an ounce, so that, with the addition of its tiny eggs, and of the light materials of its nest, the leaf is still sufficient for its support.

I shall conclude this paper with an account of a magpie's nest, by the Rev. John Hall, which exhibits ingenuity of a different kind, and by its peculiar adaptation to the circumstances of a single locality, seems to indicate a power of contrivance more allied to reason than to instinct. 'On the road between Huntly and Portsoy,' says he, 'I observed two magpies, hopping round a gooseberry bush, in a small garden, near a poor-looking house, in a peculiar manner, and flying out and into the bush. I stepped aside to see what they were doing, and found, from the poor man and his wife, that these magpies, several succeeding years, had built their nest, and brought up their young in this bush; and, that the foxes, cats, hawks, &c., might not interrupt them, they had not only barricaded their nest, but had encircled the bush with briers and thorns, in a formidable manner, nay, so completely, that it would have cost even a fox, cunning as he is, some days labour to get into the nest.

'The materials in the inside of the nest were soft, warm, and comfortable; but all on the outside so rough, so strong

and firmly entwined with the bush, that, without a hedge-knife, hatch-bill, or something of the kind, even a man could not, unless with much pain and trouble, get at their young; for the distance from the outside to the inside of the nests extended as long as my arm.

'These magpies had been faithful to one another for several summers, and had driven off their young, as well as every one else that attempted to take possession of their nest. This they carefully repaired and fortified in the spring, with strong, rough, prickly sticks, that they sometimes brought, by uniting their force, one at each end, pulling it along, when they were not able to lift it from the ground.'*

SIXTH WEEK—SATURDAY.

REPRODUCTION OF BIRDS.—NEST-BUILDING CONTINUED.—THE GROSSBEAK—THE HUMMING-BIRD.

One of the most peculiar modes of structure to be found among the feathered tribes, is that which distinguishes the *sociable* grossbeak, a particular family of the species, which is so named from its mode of building in societies. Birds of the same species inhabit the pine forests of Europe, Asia, Africa, and North America, and are also to be found in the woods of the north of Scotland. The following account of the architecture of these birds is given in Vaillant's Travels:—

'I observed in the way, a tree, with an enormous nest of these birds, to which I have given the appellation of republicans; and, as soon as I arrived at my camp, I despatched a few men with a waggon to bring it to me, that I might open the hive, and examine its structure in its minutest parts. When it arrived, I cut it to pieces with a hatchet, and saw that the chief portion of the structure consisted of a mass of Boshman's grass, without any mixture, but so compact and

* Travels in Scotland.

firmly basketed together, as to be impenetrable to the rain. This is the commencement of the structure, and each bird builds its particular nest under this canopy. But the nests are formed only beneath the eaves of the canopy, the upper surface remaining void, without, however, being useless; for as it has a projecting rim, and is a little inclined, it serves to let the rain water run off, and preserves each little dwelling from the rain. Figure to yourself a huge, irregular, sloping roof, all the eaves of which are completely covered with nests, crowded one against another, and you will have a tol erably accurate idea of these singular edifices.

'Each individual nest is three or four inches in diameter, which is sufficient for the bird; but as they are all in contact with one another around the eaves, they appear to form but one building, and are distinguishable from each other only by a little external hole, which serves as an opening to the nest, and even this is sometimes common to three different nests, one of which is situated at the bottom, and the other two at the sides.

'The large nest that I examined, was one of the most considerable I had any where seen in the course of my journey, and contained three hundred and twenty inhabited cells, which, supposing a male and female to each, would form a society of six hundred and forty individuals. Such a calculation, however, would not be exact. I have spoken above of birds, in which one male is common to several females, because the females are much more numerous than the males. The same is the case with many other species, both in the environs of the Cape, and in the colony, but it is particularly so among the republicans. Whenever I have fired at a flock of these birds, I have always shot four times as many females as males.'

The smallest, as well as one of the most interesting and beautiful of the feathered tribe, is the humming-bird, a native of America. Of this little creature there are six or seven varieties, from the size of a small wren down to that of an humble bee. It is easy to imagine how much these tiny

flutterers must add to the beauty of a rich western landscape. As soon as the sun is risen, the humming-birds of different kinds are seen fluttering about the flowers, without ever lighting upon them, in search of the insect food on which they subsist. Their wings are in such rapid motion as to make the humming sound from which they derive their name, and it is impossible to discern their colours, except by their glittering. The nests of a species, which seems to form the link in the chain that unites the feathered with the insect tribes, deserve to be noticed. Goldsmith describes them as 'suspended in the air at the point of the twigs of an orange, a pomegranate, or a citron-tree; sometimes even in houses, if they find a small and convenient twig for the purpose. The female is said to be the architect, while the male goes in quest of materials, such as cotton, fine moss, and the fibres of vegetables. Of these materials, a nest is composed of about the size of a hen's egg cut in two.

Mr. Wilson gives the following description of the nidification of the ruby-throated humming-bird. 'In Pennsylvania, the humming-bird usually arrives about the 25th of April,* and about the 10th of May begins to build its nest. This is generally fixed on the upper side of a horizontal branch, not among the twigs, but on the body of the branch itself. Yet I have known instances where it was attached, by the side, to an old moss-grown trunk; and others, where it was fastened on a strong rank stalk or weed in the garden; but these cases are rare. In the woods, it very often chooses a white oak sapling to build on, and in the orchard or garden selects a pear tree for that purpose. The branch is seldom more than ten feet from the ground. The nest is about an inch in diameter, and about as much in depth. A very complete one is now lying before me, and the materials of which it is composed are as follow:—The outward coat is formed of small pieces of a species of bluish grey lichen, that vegetates on old trees and fences, thickly glued on with the saliva of the bird, giving firmness and consistency to the whole, as well as keeping

* The humming-bird is migratory from one part of America to another.

out moisture. Within this are thick matted layers of the fine wings of certain flying seeds, closely laid together; and lastly, the downy substance from the green mullien, and from the stalks of the common fern, lines the whole. The base of the nest is continued round the stem of the branch, to which it closely adheres; and, when viewed from below, appears a mere mossy knot, or accidental protuberance. The eggs are two, pure white, and of equal thickness at both ends. On a person's approaching the nest, the little proprietors dart around with a humming noise, passing frequently within a few inches of one's head, and should the young be newly hatched, the female will resume her place on the nest, even while you stand within a yard or two of the spot.'

I cannot resist the pleasure of continuing Mr. Wilson's narrative of this delightful little tenant of the air. 'The humming bird is extremely fond of tubular flowers, and I have often stopped with pleasure to observe his manœuvres among the blossoms of the trumpet-flower. When arrived before a thicket of these that are full blown, he poises or suspends himself on wing, for the space of two or three seconds, so steadily, that his wings become invisible, or only like a mist, and you can plainly distinguish the pupil of his eye, looking round with great quickness and circumspection; the glossy golden green of his back, and the fire of his throat, dazzling in the sun, form altogether a most interesting appearance. When he alights, which is frequently, he always prefers the small dead twigs of a tree or bush, where he dresses and arranges his plumage with great dexterity. His only note is a single chirp, not louder than that of a small cricket or grasshopper, generally uttered when passing from flower to flower, or while engaged in fights with his fellows; for when two males meet at the same bush or flower, a battle instantly takes place; and the combatants ascend in the air, chirping, darting, and circling round each other, till the eye is no longer able to follow them. The conqueror, however, generally returns to the place to reap the fruits of his victory. I have seen him attack, and for a few moments tease the king-bird, and have

also seen him, in his turn, assaulted by the humble bee, which he soon put to flight. He is one of those few birds that are universally beloved, and amidst the sweet dewy scenery of a summer morning, his appearance among the arbours of honeysuckles, and beds of flowers, is truly interesting.'

'When morning dawns, and the blest sun again
Lifts his red glories from the western main,
Then through our woodbines, wet with glittering dews,
The flower-fed humming-bird his round pursues;—
Sips, with inserted tube, the honey'd blooms,
And chirps his gratitude as round he roams;
While richest roses, though in crimson drest,
Shrink from the splendour of his gorgeous breast.—
What heavenly tints in mingling radiance fly!
Each rapid movement gives a different dye;
Like scales of burnish'd gold, that dazzling show,
Now sink to shade,—now like a furnace glow.'

SEVENTH WEEK—SUNDAY.

ON THE DOMESTIC AFFECTIONS.

Our admiration is called for continually, in observing those adaptations which are visible to the eye, and the multitude more which are revealed by the telescope; and, in our feeble degree, we apprehend them, and say 'they are all very good.' But there are invisible, and moral, and mental adaptations, of equal power, and of more deep and permanent influence, the absence of which would alter the whole character of the world, nay, would tear up by the roots the whole system of things. We have been invited to rejoice that the prevailing colour of the earth is not scarlet, which would wound the sight, but green, which refreshes it;—that the liquid which slakes the thirsty creation is of crystalline purity, instead of a turbid mass of atoms, and that its perfect insipidity enables

man to mingle it with every thing, without conveying a wearisome sameness of flavour;—that to satisfy the appetites necessary to sustain our frames, is gratifying, instead of painful, distressing, or disgusting. These, and a thousand other adaptations, we own, with admiring gratitude, to be the work of beneficence, unbounded as its ingenuity is inexhaustible. But from these, I conceive, we rise to a higher station, when our attention is fixed on the machinery of loves and hatreds, by which the moral world is governed, and to which the feebleness of youth, and the infirmity of old age, alike owe their support. Notwithstanding the calamity which plunged man from his holy state of love unmingled with selfishness, and of benevolence unexcited by suffering, into a condition where self-love is necessary, in part, to self-preservation, and where affection is not trusted to spontaneous emotion, but is excited, nay, even demanded, to counteract a constant tendency to suffering,—notwithstanding this disordered state of things, love of others is the ruling principle of the world; and it is impossible that it should be otherwise, so long as the God of love continues to govern it. The earliest springs of life are linked with love. The very brutes seem, in their maternal capacity, to arise to something of moral beauty, and intelligent sentiment. What lover of Nature has not traced a gleam of benevolence in the poor ass, when giving nourishment to, or observing the gambols of, her young one, who exhibits, in his kind, marks of infantine beauty and fondness? Who that has observed the complacent and benign countenance of the lioness, when nourishing her cubs in her cage, but has wondered to see the ferocity of the beast of the forest swallowed up in parental love? Who that has read of the wounded Polar bear, fleeing from the ice-bound ship, yet stopping, in the midst of her agony, to lift first one of her young ones, and then the other, and fling it, as far as her strength would allow, out of the reach of her pursuers, has not felt his heart swell in sympathy with the afflicted monster? Was there not that in her love and care, in the midst of her own mortal agony, which elevated the shaggy beast to the verge of human emo-

tion? Has not even the heart of the rough backwoodsman smitten him, when his skilful imitation of the cry of a wounded fawn has made the ever-watchful and tender doe start into his view, within the range of his gun?

But, rising above these tokens of affection amongst the beasts, which, from their brief duration, have been by man estimated as only on the level of instincts, let us examine affection as it operates in the human being, securing not only the production, but the tender preservation and rearing of offspring, in spite of all obstacles and difficulties. How often may the parents be observed, whose more tender and refined feelings have lain always uncultivated, or have been repressed and subdued, as if too delicate a type for the rude soil of poverty and privation, who are yet, in the parental character, exercising self-denial and hard exertion. The virtuous day-labourer, living more abstemiously, that he may bestow the blessing of teaching and of school-books on his children; and the careful mother, consuming not the day only, but a portion of the hours of the night, in repairing and fitting out her children, that they may go to school or to work, are sights with which Scotland is happily familiar. These are the actions which meet the eye, but the spring of the actions is beyond human sight; it is with the God who planted love in the heart, and who is himself the fountain of love. He hath set the solitary in families; and has so formed even his fallen creatures, that the first emotions called into action, are emotions of benevolence. Have we not seen the mother, whose only home is the wretched cloak which hangs on her, press even the child of her shame and sorrow to her forlorn breast, —poor in every thing, save in maternal tenderness? Have we not seen the miserable child look up and smile, and, kindling at her eye, learn to love in return? Place such an one, with the babe who consumes her scanty sustenance in one arm, and the basket which contains her slender merchandise in the other, in a position of danger, and force her to choose which she will sacrifice,—her 'bread winner' or her babe. The selection will be the work of a moment. Her babe will

be clasped the closer to her bosom, and the wares, on which their livelihood depends, flung away; and this, not upon a process of reasoning concerning the comparative worth of the objects, or the comparative guilt of sacrificing the human being; but upon the powerful and predominant feeling that she loves her babe, and, rather than part with it, would run the risk of their starving together.

The Author of our being might, if actuated by malevolence, have bound us together by the iron fetters of necessity even under the influence of hatred and animosity. We can suppose nothing else required to exhibit the condition of ceaseless woe, than families forced to dwell together, and to lend each other all the mutual aids now lent, but through a medium of aversion and disgust. To reduce the domestic affections to indifference, would rob this world of all its sunshine; and, if it spared to mourners the pangs of separation, would also deprive them of all the lights of life. But to turn affection into aversion, and love into hate, would render this world worse than a den of dragons. We can never trace how much of the minor and collateral affections spring from those first throbbings of the heart, that exist between parent and child. It is remembered even of the poor spendthrift, who has rendered himself disgusting and disgraceful to humanity, that he had parents,—that once he loved and was beloved, and some heart is still found to regard him with pity. The friendless, unconnected man, who lies waiting for his dismissal in the corner of the work-house, and whose dismissal is perhaps thought tardy in its approach by the parish officers, will yet find in the nurse of the place some stirrings of humanity; for she, too, has cherished her offspring, and he had a mother once!

Unseen, but blessed links, which twine themselves through all the ties of life! Ye are the gift of God, and your tendency is to re-aspire to him. It has been remarked by a philosopher, more curious than profound, that the very haste which hatred makes, the very misery that revenge endures till it is satisfied,—arises from the keen desire which the heart

feels to rid itself of so unwelcome a guest as animosity. Some of my readers may still remember the pleasure with which they hung on the lips of our great moral philosopher, when he, with a deeper view of his subject, said, 'Who made benevolence pleasant? was it not the Benevolent? And who made malevolence painful? was it not still the Benevolent?'*

We draw love from our mother's breast, and from the eye of our father. Love rocks us in our cradle, and beams on us in our little brothers and sisters. Ah! what a family of love had this world contained, if sin had not introduced hate, and destroyed the scene of joy. But love can restore it,—nay, love gives itself no rest till it be restored. The God who has formed the paternal affections, offers himself as our Father, not only in his character of Creator, but in the far more costly and more endearing character of Redeemer. Love contrived the plan of our rescue. Love executed it. Love urges it upon us. Love waits to bestow it.—We are dull and slow. Hark! he hastens us. 'Return unto me, and I will return unto you, saith the Lord.' 'Ye shall be mine in the day that I make up my jewels.' 'I hate putting away.' 'I will heal your backslidings, I will receive you graciously, and love you freely.' Reader, will you not try to aspire after this noble adoption,—to obtain this new and filial attachment? With this new element in your nature, your heart will become enriched by emotions to which it is now a stranger,—cleared of pangs which now harass and torment it,—and inspired by hopes which the reality will far surpass. Look then to Jesus, and, through him, to your reconciled Father; and then shall you know of a truth what it is to be loved, protected, guided, and provided for, by Parental Affection.

M. G. L. D.

* Dugald Stewart.

SEVENTH WEEK—MONDAY.

REPRODUCTION OF BIRDS.—NESTS OF SWALLOWS.

I SHALL close this selected account of nidification, by a short detail of the various peculiarities in the nest-building of the swallow tribe, one of the most remarkable, and generally favoured by man, of the winged race. 'The swallow,' says Sir H. Davy, 'is one of my favourite birds, and a rival to the nightingale; for he glads my sense of seeing as the other does my sense of hearing. He is the joyous prophet of the year, the harbinger of the best season. He lives a life of enjoyment amongst the loveliest forms of nature; winter is unknown to him, and he leaves the green meadows of England in autumn, for the myrtle and orange groves of Italy, and for the palms of Africa.' The same sentiment is poetically expressed by Anacreon:—

'Gentle bird, we find thee here!
When Nature wears her summer vest,
Thou comest to weave thy simple nest;
And when the chilling winter lowers,
Again thou seek'st the genial bowers
Of Memphis, or the shores of Nile,
Where sunny hours of verdure smile.'

Early in the spring, when the gnat and the beetle put off their earthly robes, and venture into the air, the swallow is seen returning to the British shore, from its long migration; but it does not begin to build till the sun has acquired more power, and the increasing numbers of the insect tribes promise a plentiful supply of food for its future progeny. The nest is constructed with great art, with mud carried in its bill from some neighbouring brook, well tempered, and moistened with water. It is kept firm by long grass and fibres of various plants; within, it is lined with feathers, those of the goose being preferred from their warmth, and the neatness with which they admit of being packed. There are three kinds

common to this country,—the chimney swallow; the window swallow, or martin; the sandy-bank swallow, or sand-martin. The first of these leaves its nest open at the top, the two last take care to secure theirs with some kind of covering. Wilson gives some interesting details of the building habits of these birds in America, where they differ from our swallows in various particulars, as well as in colour, which is of a bright chestnut on the belly, where ours is pure white. 'Early in May,' says he, 'they begin to build. From the size and structure of the nest, it is nearly a week before it is completely finished. One of these nests, taken on the 21st of June from the rafter to which it was closely attached, is now lying before me. It is in the form of an inverted cone, with a perpendicular section cut off on that side by which it adhered to the wood. At the top it has an extension of the edge, or offset, for the male or female to sit on occasionally. The upper diameter is about six inches by five, the height externally seven inches. The shell is formed with mud, mixed with fine hay as plasterers do their mortar with hair, to make it adhere the better. The hollow of this cone is filled with fine hay, well stuffed in; above that is laid a handful of very large downy goose-feathers. Though it is not uncommon for twenty and even thirty pairs to build in the same barn, yet every thing seems to be conducted with great order and affection.'

The window swallow, whose nest is too familiar to my readers to need any special description, is remarkable for occasionally selecting singular situations for its place of incubation, and for the tenacity with which it adheres to its choice when it has once completed the building. M. Hebert mentions a pair which built on the spring of a bell; and says that, though the concussion, when the bell was rung, prevented the young from being hatched, they continued to inhabit the insecure nest for the rest of the season. Another pair mentioned by Bingley, built for two successive seasons on a pair of garden-shears, stuck up against the boards in an out-house; and another still, attached their tenement to the

wings and body of a dead owl, hung up on the rafter of a barn, and so loose as to be moved by every gust of wind. This last was placed as a curiosity in the Leverian Museum.

Shakspeare, in his own characteristic style, has described the peculiar habits of this agreeable little bird :—

> 'This guest of summer,
> The temple-haunting martlet, does approve
> By his loved masonry, that heaven's breath
> Swells wooingly here; no jetty, frieze, buttress,
> Nor coigne of vantage, but this bird hath made
> His pendant bed and procreant cradle; where they
> Most breed and haunt, I have observed the air
> Is delicate.' MACBETH.

The singular method which the house-martin sometimes takes to revenge itself on a sparrow when it endeavours to avail itself, as it not unfrequently does, of the labours of this ingenious architect, by taking forcible possession of its habitation, has been noticed by several writers. The following instance has been detailed to me by a friend, who was an eye-witness to the whole transaction :—At Millfieldhill, in Northumberland, two pairs of swallows were accustomed to rebuild their hereditary nests, one at each upper corner of a bedroom window. One year, after the little 'clay-built sheds' were just completed, a sparrow thought proper to ensconce herself in one of them. Immediately the outraged pair began to twitter with a loud and irritated note, and darting frequently in at the door of the nest, endeavoured to dislodge the intruder. But in vain. The sparrow, protected as behind a battery, sat with her bill, a formidable weapon of defence, in the middle of the entrance, and gave so warm a reception to the besiegers, that, after a long and fierce contest, the lawful owners were obliged to yield to the fraudulent occupier; but not unrevenged. They retired for a time, along with their neighbours of the opposite corner, as if for consultation, and by-and-by were seen returning in a band, apparently to renew the struggle with these fresh auxiliaries —But no such thing; each was loaded with a mouthful of

clay, and, setting diligently to work, adhering by their claws to the outside of the nest, they had, before nightfall, completed their ingenious object of retaliation, by entirely building up the entrance to the nest, and thus leaving the robber sparrow a helpless captive, immured in a prison, where she had hoped to secure for herself a commodious habitation. Here the sparrow remained closely pent up till next morning, when a maid-servant, taking pity on the prisoner, restored her to liberty, by drawing down the upper sash of the window. This operation, however, destroyed the structures of both the friendly pairs; but, nothing discouraged, they immediately recommenced their laborious task, and, in a few days, had re-erected them on the same site. We may well inquire if it was simple instinct which led to this combination and ingenious device. And if so, our next inquiry will be, how this kind of instinct is to be defined, so as to distinguish its operations from those of reason.

There is a species of swallow called *Salanguano*, which inhabits Java, and other islands of the Indian Archipelago, whose nests are of a very remarkable construction; and, being edible, and highly esteemed by Chinese epicures, form a valuable article of commerce. They differ considerably in their composition; and the manner of procuring their materials, and constructing them, is more a matter of conjecture than of certainty. Some authors, among whom is Goldsmith, assert that the substance of these nests is a sort of froth of the sea, or of the spawn of fish, which is alleged to be strongly aromatic; some describe it as a kind of gum, collected by the birds from the tree called *Calambone;* others, again, would have us to believe, that it is a viscous humour, discharged by them through the bill at the season of reproduction. Whatever this singular substance may be, it is deposited by the swallows in deep caverns, frequently very dangerous of access, yet where human cupidity and epicurism have found means to penetrate. 'The most remarkable and productive caves in Java,' says Mr. Crawford, 'of which I superintended a moiety of the collection for several years, are those of Karan-

bolang, in the province of Baglen, on the south coast of the island. There the caves are only to be approached by a perpendicular descent of many hundred feet, by ladders of bamboo and ratan, over a sea rolling violently against the rocks. When the mouth of the cavern is attained, the perilous office of taking the nests must often be performed by torch-light, by penetrating into recesses of the rock, where the slightest trip would be instantly fatal to the adventurers, who see nothing below them but the turbulent surf, making its way into the chasms of the rocks. The common prices for these nests at Canton, are, for the most esteemed kinds, about six pounds sterling per pound weight, while the inferior sorts scarcely average more than half of that enormous sum. From Java there are exported about 27,000 lbs., the greater part of which is of the first quality. From the Saluk Archipelagoes, between two and three times that quantity is exported. It is computed, that 30,000 tons of Chinese shipping is employed in this extraordinary trade; and that the whole yearly quantity consumed is not less than 242,400 lbs. In the Indian Archipelago, at the prices already quoted, this property is worth 1,263,519 Spanish dollars, or £284,290. It forms a considerable branch of the revenues of the Crown.'

I cannot close this sketch of the various modifications of that instinct with which it has pleased the Creator to endow the winged tribes, without again soliciting attention to the variety and wisdom of the contrivances by which the safety, both of the parents and their progeny, is provided for, regarding, as they do, not merely the peculiar habits of the birds themselves, and the susceptibility of injury in their eggs and young, but their particular locality with reference to climate, and to the living creatures which exist in their neighbourhood. I have already noticed a remarkable instance of this latter kind of adaptation, in the different kinds of nests formed by the woodpeckers of Europe and of America; and I think the reader will join me in a similar observation with regard to the swallows of India, as compared with their congeners in our own quarter of the world. Here this tribe

are strikingly familiar with their fellow inhabitants of the human race. There is nothing in the materials of their nests which man can covet, and they therefore freely throw themselves on the protection of that lord of the creation. But it is very different in the Indian Archipelago. There, from some peculiarity with which we are not acquainted, the swallows are made to build their 'procreant cradles' of materials which man eagerly covets as food; and, therefore, these little tenants of the air are taught to retire to deep and dangerous caverns, which their wings enable them easily to penetrate; but where nothing but a morbid and pampered appetite could induce man to pursue them.

SEVENTH WEEK—TUESDAY.

REPRODUCTION OF BIRDS.—HATCHING OF EGGS, AND REARING THE BROOD

When the nest is prepared, the bird is instructed, by Him who has so mysteriously provided for the propagation of the mortal beings he has created, to lay that number of eggs which she can safely rear, or which, in his infinite wisdom, he finds best calculated for preserving the balance of living beings. I have already observed, that there is in this, as in other departments of Nature, a distinct evidence of beneficent contrivance in the general law which regulates the number of eggs hatched by each species—inasmuch as, that birds of prey, which are intended to restrain within certain bounds, but not to exterminate, the smaller tribes, produce very few; while the other orders, in proportion to their helplessness and liability to destruction, produce a more numerous progeny. It is curious to observe the instinct which regulates this. The bird, by its natural constitution, is capable of laying many more eggs than she actually produces in one season; but, as soon as she finds her nest sufficiently replenished, she desists from laying, of her own accord, and by an apparently

voluntary act. The domestic fowl is a familiar example of this. Although she is capable of producing eggs through the greater part of the year, yet, if her nest be left undisturbed, she will refrain from laying, and begin to brood, as soon as she finds that she has laid as many as the heat of her body can easily warm. That this is the case with wild birds also, I remember having myself, when a school-boy, proved by an experiment. Having found the nest of a yellow-hammer—a bird for which school-boys have no tenderness—I carefully abstracted one of the three eggs which it contained, when the bird did not appear to be within observation, and, next day, was delighted to find another laid in its stead. This also I abstracted; and, day after day, I continued to do the same thing, till I was in possession of fifteen eggs. The bird then deserted her nest, having laid three times the number of eggs she would have done had I not been guilty of this somewhat cruel depredation.

The anxious care and patient endurance, with which the duty of incubation is performed, is worthy of the highest admiration. 'Nothing,' says Goldsmith, 'can exceed the patience of birds while hatching; neither the calls of hunger, nor the near approach of danger, can drive them from their nest. They are often fat when beginning to sit, yet, before incubation is over, the female is usually wasted to skin and bone.' Addison, in his own elegant language, thus speaks of the instinct of the domestic fowl:—'With what caution does the hen provide herself with a nest in places unfrequented, and free from noise and disturbance! When she has laid her eggs in such a manner, that she can cover them, what care does she take in turning them frequently, that all parts may partake of the vital warmth! When she leaves them, to provide for her necessary subsistence, how punctually does she return, before they have time to cool, and become incapable of producing an animal! In summer, you see her giving herself greater freedoms, and quitting her care for above two hours together; but in winter, when the rigour of the season would chill the principles of life, and destroy the young one,

she grows more assiduous in her attendance, and stays away but half the time. When the birth approaches, with how much nicety and attention does she help the chick to break the prison !*—not to take notice of her covering it from the injuries of the weather, providing it with proper nourishment, and teaching it to help itself; nor to mention her forsaking the nest, if, after the usual time of reckoning, the young one does not make its appearance. A chemical operation could not be followed with greater art or diligence, than is seen in the hatching of a chick, though there are many birds that show an infinitely greater sagacity ; yet, at the same time, the hen, that has all this seeming ingenuity (which is, indeed, absolutely necessary for the propagation of the species), considered in other respects, is without the least glimmerings of thought or common sense. She mistakes a piece of chalk for an egg, and sits upon it in the same manner ; she is insensible of any increase or diminution in the number of those she lays ; she does not distinguish between her own and those of another species, and, when the birth appears of never so different a bird, will cherish it for her own. A hen, followed by a brood of ducks, shall stand affrighted at the edge of the pond, trembling for the fate of her young, which she sees venturing into so dangerous an element. As the different principle which acts in these different animals, cannot be called reason, so, when we call it instinct, we mean something we have no knowledge of. It appears to me the immediate direction of Providence ; and such an operation of the Supreme Being, as that which determines all the portions of matter to their proper centres.'

The following just observations from the 'Journal of a Naturalist,' suggested by the maternal instincts of the missel-thrush, shall close this paper. 'The extraordinary change of character which many creatures exhibit, from timidity to bold-

* Addison has here fallen into the error of the earlier naturalists, that the chipping of the egg was the act of the mother; he has also committed another error, in saying that the bird frequently turns her eggs ;—but his general reasoning is not affected by these mistakes.

ness and rage, from stupidity to art and stratagem, for the preservation of a helpless offspring, seems to be an established ordination of Providence, actuating, in various degrees, most of the races of animated beings; and we have few examples of this influencing principle more obvious than this of the missel bird, in which a creature addicted to solitude and silence, will abandon its haunts, and associate with those it fears,* to preserve its offspring from an enemy more merciless and predaceous still. The love of offspring—one of the strongest impressions given to created beings, and inseparable from their nature—is ordained by the Almighty as the means of preservation under helplessness and want. Dependant—totally dependant, as is the creature for every thing that can contribute to existence and support, upon the great Creator of all things, so are new-born feebleness and blindness dependant upon the parent that produced them; and to the latter is given intensity of love, to overbalance the privations and sufferings required from it. This love, that changes the nature of the timid and gentle to boldness and fury, exposes the parent to injury and death, from which its wiles and cautions do not always secure it; and in man, the avarice of possession will at times subdue his merciful and better feelings.

'Beautifully imbued with celestial justice and humanity, as all the ordinances which the Israelites received in the wilderness were, there is nothing more impressive, nothing more accordant with the divinity of their nature, than the particular injunctions which were given in respect to showing mercy to the maternal creature cherishing its young, when, by reason of its parental regard, it might be placed in danger. The eggs, the offspring, were allowed to be taken; but, 'thou shalt in any wise let the dam go,'† 'thou shalt not, in one

* It had been previously observed that this bird, to avoid the depredations of the crow and magpie, frequents our gardens and orchards during the breeding season, seeking protection from man, near whose haunts these rapacious plunderers are wary of approaching.

† I have already mentioned one of my school-boy experiments. Here is another, much less justifiable, and attended with a more distressing re-

day, take both a ewe and her young'—the ardent affection, the tenderness with which I have filled the parent, is in no way to lead to its injury or destruction. And this is enforced, not by command only, not by the threat of punishment and privation, but by the assurance of temporal reward, by promise of the greatest blessings that can be found on earth—length of days and prosperity.'*

SEVENTH WEEK—WEDNESDAY.

REPRODUCTION OF QUADRUPEDS.—THE LION—THE RABBIT.

It is unnecessary to dwell at any length on the reproductive instincts of quadrupeds, as the great principles by which such instincts are guided, have already amply appeared in

sult, which strikingly illustrates the benevolence of the Divine command alluded to in the text, and the cruelty of neglecting it. I took a brood of young chaffinches in the nest, and, having placed them in a cage, in a room, near an open window, their cries drew both the male and female to their aid. Laying aside her usual timidity, the affectionate mother flew in at the window, and rested on the cage. At that moment, by drawing a string, I suddenly closed the window, and thus made her my prisoner. My object was to get her to feed her young, with food regularly supplied to her by myself, and thus to provide for the proper rearing of the tender brood. The experiment altogether failed, and I suffered the reward of my treachery. The imprisoned female was uneasy and restless, and took little notice of her young, while the male fluttered about the window, in great agitation, but never ventured to enter. I persuaded myself, that if I could catch him also, all would be well, and I therefore secured him by means of bird-lime. Both parent birds were then enclosed in the same cage with their offspring, along with abundance of meat; but next day all the young ones, with their mother, were lying wounded and dead at the bottom of the cage. The high-spirited male preferred the death of his family to their captivity. He would probably have immolated himself also on the shrine of freedom, as he refused to eat, but I was too much shocked by the catastrophe to carry the unhappy experiment further. The bird regained his liberty, and flew lonely, and uttering plaintive cries, to his native grove.

* Journal of a Naturalist, pp. 248–250.

considering those natural faculties, as exhibited among the feathered tribes, where peculiar circumstances require them to be more complicated and more perfect. A slight notice, however, will not be uninteresting, or out of place.

The chief difference in the manner of propagating the species between birds and beasts, is, that the latter, instead of producing by means of eggs, are *viviparous;* or, in other words, the process of incubation is, with them, carried on in the womb, and the young are parted from the mother, as the chick is, after hatching, excluded from the shell alive, and fully formed. Another provision is united with this, the adaptation of which to the peculiar circumstances of quadrupeds, is also admirable, with relation to the case both of the mother and her offspring; I mean the supply of milk from the udder of the female, a secreted fluid, prepared by the profoundest alchemy, for the nourishment of the progeny, in the earlier stage of their existence. These two differences render the cares of the parent less numerous and burdensome. There is neither a nest to prepare, nor food to gather for the young; the Author of their nature has already provided both. Now, we observe a corresponding difference, adjusted with singular intelligence to these modifications. The male, among quadrupeds, never performs as important a part in the rearing of the young, as among birds. Frequently, indeed, he is altogether ignorant of the paternal feelings. It is not necessary, for the welfare of the species, that this natural affection should exist in ordinary cases, and especially among gregarious beasts; and, except where it is necessary, it has not been bestowed. The sheep, the cow, the dog in its wild state, and various others, are instances of gregarious quadrupeds, the males of which are altogether destitute of the parental instincts.

There are other kinds of beasts, however, who pair, and in whom these instincts are sufficiently conspicuous. This is constantly the case with beasts of prey, who, as I have already remarked, have to seek their food at a distance, encountering much toil, and sometimes imminent danger, and with regard

to whom it was therefore expedient that the male should be the associate and provider of the female, while tending their mutual offspring. Let us take an example, in the noblest of the brute creation, the imperial lion.

This royal animal is constant to one female. They lie in the same thicket or den; they partake of the same prey; and, when the breeding season arrives, they are animated by the same feverish excitement. Even when fierce and irritable to all others, the lion is mild and gentle to the female. That he is susceptible, indeed, of kindly and generous feelings, even to animals of a different species, has been proved by the attachments which have been known to subsist between this formidable animal, in a state of confinement, and creatures which have been thrown into his den to be devoured; and the same thing may probably be inferred from his tractability and gentleness in the hands of his keeper. But it is towards the lioness and her cubs that his affections are peculiarly alive; and some interesting stories have been recorded, indicating the tender feelings towards them, with which the Creator has endowed him. In this animal, indeed, all the passions, even those of the most gentle kind, are in excess.

The lioness, though naturally less strong, less courageous, and less mischievous than the lion, becomes terrible when she has got young ones to provide for. She then makes her incursions with more intrepidity than the lion himself; she throws herself indiscriminately among animals of all kinds, and even man, whom, in her ordinary state, she is shy of attacking, becomes the object of her fury. She destroys without distinction; loads herself with the spoil, and brings it home reeking to her cubs, whom she early accustoms to delight in slaughter. Her period of gestation is five months, and she bears only once in the year, generally bringing forth two at a time, though sometimes more. Her lair is in the most retired and inaccessible places; and, when she fears to have her place of retreat discovered, she is said, how truly I do not know, to hide her tracts, by brushing them out with her tail. When her apprehensions are strong, she shifts her

habitation, carrying the young, if newly dropped, one by one in her mouth, like the dog or cat. If attacked when performing the maternal duties, she fights with peculiar fury, defending her offspring with the most determined courage, and a love which no personal danger can shake.

Such is the account given by naturalists, of this most formidable of the brute creation. It exhibits the parental and conjugal affections not less strong in this tremendous quadruped, than in the interesting tribes which skim the air, and teaches us that the Creator has implanted, even in the fiercest brutes, the same kind of instincts, by which he has provided for the propagation of the species among birds, though these are wonderfully modified, so as to adapt them to the circumstances of each.

I shall contrast the habits of the lion with those of one of the most peaceful and defenceless of the quadruped race, in its natural and untamed state. The rabbit shall be my example. This animal, destitute of the swiftness of the hare, and the cunning of the fox, and the agility of the squirrel, has but one means of escape from danger; he burrows beneath the ground. When the necessity of procuring food, and the love which he seems instinctively to feel for the open air, tempt him to go abroad, he becomes the prey of every carnivorous animal; and the race, apparently created to be the food of the fox, the kite, and the eagle, would soon become extinct, were it not for its extraordinary fecundity. This property I noticed in the Winter volume.* It is so great as amply to compensate to the race for the defencelessness of their nature, and is one of those provisions of Creative Wisdom, by which the balance of creation is preserved.

The female prefers solitude during the period of production; and, as the holes in which the rabbits usually burrow, are common property, she frequently provides a nest for herself, on the outside of the warren, and at some distance from it, excavated about a foot deep, and filled with moss and grass. Here she suckles her young for about a month, generally

* 'Winter,' Fourth Edition, p. 79.

alone, but sometimes visited by the male, who, though he would destroy them, when newly dropped,* occasionally attends their mutual offspring, after they are grown up, nursing them in her place, when she is procuring her own food, and leading them out to feed. It is most usual, however, for the female to produce her young within the warren; but, in a separate apartment, made with a more intricate entry than the ordinary holes, at the bottom of which a sufficient space is excavated. Here she pulls off from her belly a good quantity of her hair, with which she makes a kind of bed for her young. During the two first days after their birth, she never leaves them, and does not stir out even afterwards, except to procure nourishment, which she snatches with the utmost despatch. In this manner, she suckles her young for six weeks, at which time they have become strong, and able to go abroad themselves. During all this time, the male seldom visits the apartment; but when they are grown up, so as to come to the mouth of the hole, he then seems to acknowledge them as his offspring, takes them between his paws, smooths their skin, and licks their eyes. All of them, one after another, have an equal share of his caresses.

These specimens, taken from two very different tribes of animals, may suffice to show that peculiar modification of the reproductive instincts, by which the Creator has admirably accommodated them to the circumstances of the animals endowed with them, thus affording, in this department of his works, additional evidence of Divine skill and benevolent contrivance.

SEVENTH WEEK—THURSDAY.

REPRODUCTION OF QUADRUPEDS.—INSTINCTS OF THE YOUNG.

THERE is a curious experiment, made by Galen, which Mr. Ray has copied from his narrative illustrative of the in-

* It is probably from jealousy of the female's affection for the young, that the buck shows enmity to their offspring.

stinctive habits of the young of brutes. It is as follows, in the words of Mr. Ray's translation :—'Nature, forming, fashioning, and perfecting the parts of the body, hath so brought it to pass, that they should, of themselves, without any teaching, set about, and perform, their proper actions; and of this I once made a great experiment, bringing up a kid without ever seeing its dam; for, dissecting some goats, great with young, to resolve some questions made by anatomists, concerning the economy of nature, in the formation of the fœtus in the womb; and, finding a brisk *Embryon* (young one), I loosed it from the matrix, after our usual manner, and, snatching it away before it saw its dam, I brought it into a certain room, having many vessels full, some of wine, some of oil, some of honey, some of milk, or some other liquor; and others, not a few, filled with all sorts of grain, as also with several fruits; and there I laid it. This embryon we saw first getting up upon its feet, and walking, as if it had heard that its legs were given it for that purpose; next shaking off the slime it was besmeared with from the womb; and, moreover, thirdly, scratching its side with one of its feet. Then we saw it smelling to every one of those things that were set in the room; and, when it had smelt to them all, it supped up the milk; whereupon we all, for admiration, cried out, seeing clearly the truth of what Hippocrates saith, that the nature and actions of animals are not taught, but by instinct. Hereupon I nourished and reared this kid, and observed it afterwards, not only to lap milk, but some other things that stood by it; and, the time when this kid was taken out of the womb, being about the vernal equinox, after some two months, were brought to it the tender sprouts of herbs and plants; and it again, smelling of them all, instantly refused some, but was pleased to taste others; and, after it had tasted, began to eat of such as are the usual food of goats.

'Perchance this may seem a small thing; but what I shall now relate is great; for, eating the leaves and tender sprouts, it swallowed them down, and then, a while after, it began to chew the cud, at which, all that saw it, cried out again, with

admiration, being astonished at the instincts and natural faculties of animals; for, it was a great thing, that, when the creature was hungry, it should take in the food by the mouth, and chew it with its teeth; but, that it should bring up again, into the mouth, that which it had swallowed down into its first stomach; and, chewing it there a long time, it should grind and smooth it, afterwards swallow it again, not into the same stomach, but into another, seemed to us wonderful indeed. But many neglect such works of nature, admiring only strange and unusual sights.'

On this account, Mr. Ray makes the following observations:—'This pleasant and admirable story, should one consider all the particulars of it, and endeavour to give an account of them, as also all the inferences that might be drawn from it, one might fill a whole volume with comments upon it. All that I shall at present say is this, that, in all this economy, and these actions, counsel and design doth so clearly appear, that he must needs be very stupid that doth not discern it, or impudent that can deny it.'

It is impossible not to assent to these observations; but, after all, the only thing unusual in the account, is the absence of the mother, and the impossibility of the kid learning any thing from mere imitation—an idea which could scarcely occur to a rational inquirer. The very same thing happens every day. It is true, indeed, that the embryon, as he calls it, drew its food from a vessel, and not from its mother's nipple, but the one process is not less remarkable than the other. Indeed, nothing can be more admirable than the whole contrivances and adaptations by which this grateful and nutritious liquor is prepared, and rendered available for the subsistence of the young. The udder itself is composed of an immense number of glands, or secreting vessels, where the milk is formed, each of which has its duct, through which it is conveyed, first into small trunks or branches, and then into one large excretory vessel; and this, before it enters the nipple, is contracted to such a degree, that it will scarcely admit a small bristle to pass into it. By this beautiful artificial contrivance,

the milk is prevented from flowing out of itself, while it is made ready easily to flow out, when acted on by suction or pressure. Corresponding to this, and most evidently forming a part of the same contrivance, is the mouth of the young, formed for suction; and, at that early stage, divested of teeth, which would at once be an annoyance to the mother, and an unnecessary appendage to the offspring.

But I must farther remark, that the various actions which Galen observed, with such admiration, in the kid, have their analogies in the young of almost all quadrupeds, and are indeed necessary to the propagation of the species. In the insect tribes, these instincts are not less complete. Every one who has the advantage of a glass-hive, must have remarked, with delight, the motions of the young bee, when it emerges from its waxen cradle. It stands, for a minute or two, on the comb, by the side of its cell, holding as steadily, with its tiny feet, as if it had known their use for months; it then cleans itself with its fore-legs and antennæ, with admirable adroitness, rubbing its body, and smoothing its wings; and, after this slight preparation, it walks deliberately, and without any teaching, along the comb to the mouth of the hive, where it instantly mounts into the air, and finds its way to the honey-bearing flowers, employing its wings and its proboscis as skilfully as if it had been taught the art of flying, and of imbibing it selected food, by the most accomplished master. By such a master, indeed, it has been taught; but that master is no other than the Unseen Creator.

I am reminded, by the course of these observations, of an instinct belonging to the winged tribes, in the feeding of their young, to which I have not yet adverted, but which is not less remarkable than those already mentioned. I state it in the words of Ray:—'That birds which feed their young in their nest, although, in all likelihood, they have no ability of counting the number of them, should yet (though they bring but one morsel of meat at a time, and have not fewer, it may be, than seven or eight young ones in the nest together, which, at the return of their dams, do all at once, with equal

greediness, hold up their heads and gape), not omit or forget one of them, but feed them all; which, unless they did carefully observe, and retain in memory, which they had fed, which not, were impossible to be done,—this, I say, seems to be most strange and admirable, and beyond the possibility of a mere machine to perform.'*

SEVENTH WEEK—FRIDAY.

MAN.—EFFECTS OF PROTRACTED CHILDHOOD ON THE INDIVIDUAL.

We are now arrived at the highest state of organized existence, in which the most perfect of all the bodily forms is united with an immortal soul, capable of being stimulated to unwearied exertions, susceptible of endless improvement, and glowing with desires which rise beyond the bounds of time. In recording the formation of the inferior classes of living beings, it is merely stated by the sacred historian that God said, 'Let them be;' but when the formation of man is recorded, it is declared, that 'God created man in his own image;' and that 'he became a living soul.' This emphatically marks his nobler faculties and his higher destiny. But when, by the fall, his nature was degraded, and his hopes were blasted, he was doomed to live on earth an imperfect and sinful creature; and, doubtless, one of the Providential means by which the curse he had entailed upon himself was communicated to his posterity, was the appointed condition of their mental powers in the earlier stages of their existence. The maturity of their appetites and passions was thenceforth to precede the maturity of their rational and moral faculties, and thus to obtain a superiority which was to destroy the well-adjusted balance of their nature, that constituted the perfection of man when he came from the hands of his Creator.

Man was not, however, to be left without some counteracting circumstances, which should tend to prevent this condition

* Ray on the Creation, p. 107.

from becoming altogether fatal to his intellectual progress, and his virtuous aspirations. Among these the most powerful, and the only one I shall at present notice, is what results from the other conditions in which during infancy he is placed.

Of all the animal creation, the bodily powers of man are by far the longest of being fully developed. He comes into the world a helpless infant, totally incapable of providing for his own subsistence. He is thus for several years thrown entirely dependant on the good offices of his parents. I have already noticed this as a wise Providential arrangement;* but as it is one of the peculiar adaptations connected with the reproduction of the species, it seems here to require a more particular examination.

If any person were but for a moment to consider what would be the necessary result of an opposite condition, he would perceive at once the wisdom of the provision. Let him suppose, what might assuredly have taken place had the Creator so pleased, that the child was formed so as to rise to bodily strength, and to be able independently to find the means of subsistence in the same short period as the young of a sheep, a cow, or a horse, what would be the consequence to himself, to his parents, and to society? It is obvious to the reflecting mind at a single glance, that in every one of these particulars, the effects would be injurious; but all the evil results cannot easily be perceived without some consideration. Let us then inquire into this matter.

Observe the consequence to himself.—We shall best do this by first considering the discipline which a child actually undergoes under the roof of his parents. The earliest enjoyments of which he is conscious, arise from the tender assiduities of maternal fondness.—His smile responds to that of his mother; when he weeps, it is her soothing voice which calms the inward agitation of his feelings; when he is hungry, it is from her bosom that he draws the sweet food with which his appetite is satisfied; when he becomes fatigued and listless, it is her lullaby which charms him to sleep; and, clasped in

* 'Winter,' Fourth Edition, p. 305. See also p. 121 of this volume.

her arms, it is on her soft and gentle breast that he pillows his head. Thus a sympathy is excited between the parent and child, which has a powerful effect on his character. He learns to lean upon his mother for that support of which he stands in need, to look up to her for enjoyment, to hang on her looks with a tender interest. His benevolent affections, in short, are called forth and exercised; and, along with these, arise a feeling of natural helplessness; a salutary sense of dependance on a superior; docility, and a desire to please; which complete the filial, and lay the foundation of the religious, affections. These filial charities and duties, thus early called forth, are exercised and expanded during a period which occupies not less than the fourth part of our sublunary existence; and, thus riveted on the character, become a second nature; or, at all events, so modify and control the moral powers, as to give them a salutary direction through life. It may be difficult to determine to what degree any of the qualities and tendencies I have mentioned would influence the mind of man, were he not by the very necessity of his circumstances thus trained, coerced, and moulded; but that much of what is amiable and estimable in his character would be lost, no person can doubt. Alas! notwithstanding all the training of the domestic roof, what proofs remain of the debasement of our moral powers!

But this is not all.—Besides the moral effect thus produced, the influence of this long state of filial dependance is scarcely less salutary on the intellectual powers. Under a parent's roof, the mental faculties are excited and cultivated. The little attentions of maternal fondness all tend, unconsciously even to the mother herself, to awaken the curiosity, to exercise the reason, and stimulate the ingenuity of her child. When she first teaches him to grasp the offered toy, and leads him to use his rattle, or to chuckle with delight while she forms for him a horse of his father's cane, new ideas are constantly rising in his mind, and a habit of mental activity is forming, which is not without its permanent influence. Were we to follow the domestic discipline after the child

leaves his mother's lap, we would find still greater reason to admire the divine wisdom, which has thus provided for the development of his rational powers. It is a parent's authority which not only restrains the evil passions as they rise in his childish breast, but trains him to a course of mental improvement. It is the persuasive eloquence of a beloved mother's admonitions, or the reverential awe of a father's command, which induces the youthful mind to forego its indolence and love of amusement; to acquire useful but irksome instruction in the public school, or under the anxious and experienced eye which presides over the domestic circle.

Let us now look for a moment to the supposition with which we set out.—Imagine man exempted from this long-protracted pupilage, and rising to the full vigour of his bodily powers in a few weeks or months, and consider the result. Being thus early rendered independent of parental tenderness and support, the endearing tie, which binds the parent to the child, and the child to the parent, would at once be materially weakened. That ceaseless assiduity and inexhaustible tenderness which is called forth on the part of the mother, by the utter helplessness of her infant charge, would abate with the necessity from which it sprang. She would still love him indeed, but her affection would be less deep and exclusive; she would still attend to his wants, but they would be less numerous and pressing, and their urgency would cease before they had been formed into a permanent habit, and had entwined themselves very strongly round her heart. On the part of the child, the effect would be still more injurious. The love and gratitude which parental kindness now engenders, if it existed at all, would be very greatly diminished. There would be no remembrance of the mother's long nights of watching, and the father's days of unwearied toil, to enhance the feeling;—no consciousness of that generous parental regard, which sacrifices self for the welfare of his child, or, at least, no depth of tender sympathy, excited by that consciousness, and rendered indelible by the experience of many years. As the youthful mind expanded, the heart would grow callous. Selfishness,

which even now takes so strong a hold of the human character, would then possess it undivided;—there would be no melting charities, no relenting ruth; from generation to gen eration the degeneracy would increase, and the whole earth would probably become a habitation of cruelty.

The same deteriorating influence would extend to the intellectual world. The mental powers would cease in early youth to be cultivated. Emancipated from parental control, the childish and inexperienced man would refuse the drudgery of school, and all those painful exercises of mind which train it to learning. There would be no books, no study, no science. The untutored mind would remain without light and without employment,—a savage with tenfold more darkness, ferocity, and intense selfishness, than the most uncultivated and fierce of the savage tribes of Africa.

It were easy, but seems unnecessary, to follow this part of our subject farther. It is clear and undeniable, that for man, constituted as he is, the early discipline of a father's roof is of most essential importance; that even supposing the picture I have drawn to be overcharged, of which I am by no means aware, yet, to say the very least, without such discipline the moral character would be still more defective than it is, and the intellectual powers obtuse and uncultivated; and that therefore, with reference merely to the effect on the child, the arrangement which leaves him long weak, helpless, and dependant, unequivocally argues the contrivance of Divine wisdom and goodness.

SEVENTH WEEK—SATURDAY.

MAN.—EFFECTS OF PROTRACTED CHILDHOOD ON THE PARENTS AND ON SOCIETY.

It is not on the young alone that a salutary effect is produced by the protracted period of infancy. Whatever, indeed, forms the character of the child, provided the effect, as

on the present supposition, be permanent and universal, must, in the second generation, influence the character of the whole race, so that there would be much reason for thankfulness, even although the arrangement in question were to produce no other direct advantage, than that on which I have already commented. But, besides the character formed in childhood under a parent's roof, there are benefits arising to the parents themselves, from the lengthened state of dependance which the Creator has entailed on their children.

It is the cement of the marriage tie. Man, like many of the inferior creatures, is a gregarious animal, and, in this state, we seldom find that any very close and endearing connexion subsists between the parents, except, as in the case of birds, the production of offspring be attended with many cares, extended over a considerable period. It is easy to see, that the very same principle operates with man as with the birds. The husband 'leaves his father and mother, and cleaves unto his wife, and they twain become one flesh.' And what renders this intimate and permanent connexion a natural as well as a commanded duty? Chiefly, though not solely, the tie formed between them by a helpless family, mutually endeared as being their own flesh and blood, and depending wholly upon them for support and education. There is here a bond of union of long continuance and of great responsibility, even where there is only one child; but frequently renewed by additional progeny, and increasing with the increasing family. In the rearing, training, and providing for these pledges of mutual love, their sympathies are strongly called forth, their energies are united, their labours are lightened, their sorrows are alleviated, their hopes and enjoyments are exalted. Affection begets affection. The glance of love flashes from parent to parent, and then from the parents to their fondly cherished offspring; whence it is reflected with a softened lustre from the guileless eyes of infancy and childhood. The endearing influence spreads and accumulates. Mutual benefits, conferred and received, complete the union; and thus are formed and rendered permanent the tender charities of do-

mestic life; which, in reference to the intercourse of human beings, constitute at once the most important of man's earthly duties, and the most ennobling of his earthly enjoyments.

But the stimulus which parental love excites is not confined in its advantages to the family circle. Industry is necessary for the supply of domestic wants; and industry is the road to wealth. 'The hand of the diligent maketh rich;' conveniences succeed to necessaries; comforts to conveniences; and so the stimulus urges forward. Ingenuity is demanded; invention succeeds; the produce of the rivers and the forests are put in requisition; the powers of the soil are called forth; the arts and sciences take their origin and are cherished; and man, rising as he advances, emerges into civilized life, and becomes conscious of powers, susceptible of enjoyments, and capable of an expansion of mind, which, in the ruder stages of society, he could not even comprehend. And all this arises, or at least receives strength and permanence, from that one arrangement on which the domestic bond is founded,—the protracted period of pupilage.

Nor is even this all. From the patriarchal state, government and the social compact take their rise, and all the advantages accrue, which are secured by a well-regulated and closely-united community. The mutual relation of parent and child, implies authority on the one hand, and obedience on the other. This is the principle on which all government is founded; and we may well doubt whether, if family ties did not exist, men would ever unite together in communities, and place themselves under the useful restraints of law. If not, then the hope of improvement would be at an end. 'Every man would do that which was right in his own eyes;' and rapine, oppression, and bloodshed, would pervade the world.

'There is a holy tenderness,
A nameless sympathy, a fountain love,—
Branch'd infinite from parents to their children,
From child to child, from kindred on to kindred,
In various streams, from citizen to citizen,

From friend to friend, from man to man in general,
That binds, supports, and sweetens human life.'*

Then, again, consider what would be the state of religion, that softener of the manners, that enlightener of the mind, that solace and hope of the heart; that bond of union and of sympathy among brethren. Doubtless the Spirit of God might move over the chaotic and jarring mass of humanity, as he at first moved on the face of the waters, and produce a new moral creation,—a power which, under all circumstances, indeed, must be exerted before fallen man can be renewed in the spirit of his mind. But who does not perceive, that, under the circumstances we are supposing, the world of mankind would be totally unprepared for such a change. At present, they have learned, in the school of domestic discipline, to reverence, to love, to trust, and to obey their parents, and their affections have early and habitually gone forth towards their brothers and sisters. Here God has laid a foundation for the religious principle. It is but transferring the filial affections from an earthly to a heavenly Father; from their brethren of the family circle, to their 'elder Brother' before the throne of the Eternal; and thence, by reflection, down again to earth, that all the large family of the second Adam may be bound together by the ties of spiritual brotherhood. But if there were no domestic training and sympathies, those principles on which the religious affections are founded, would be in abeyance in the human character. There would be a want of preparation, and an obtuseness of feeling exceedingly unfavourable for the operation of religious convictions and spiritual mindedness. The soil on which the seed of Divine truth was to be sown, would be barren and impenetrable. God, indeed, could still fertilize it; and sometimes he shows the sovereignty of his grace, by bringing unexpected fruit from the most unpromising soil; but this is not the way in which the Holy Spirit usually works. When the Son of God appeared, he found the world prepared for his reception, by a long period of previous training: and so it is in the or-

* Thomson's Sophonisba.

dinary course of Providence; when Divine grace converts a soul, it generally operates on principles and feelings already in exercise, though misapplied, perverted, and debased. Of this we have a memorable instance in Saul the Persecutor converted, and applying the same characteristic zeal in a new direction, when he became Paul the Apostle. And thus we find it here. God has 'set the solitary in families,' that they may imbibe and cherish principles, which require only to be changed to a more exalted and more worthy object, and, by the infusion of a new principle, to be refined and sanctified. Reverence, love, and gratitude,—docility, submission, and obedience, have already been cultivated in the domestic circle, and are in frequent exercise. They have but to be enlightened, purified, and ennobled, by faith in the Saviour of sinners; and the joyful change is effected.

From these remarks, I think it will appear, that the peculiar arrangements which give rise to the domestic charities, the chief foundation of which, as I have said, is to be found in the protracted period of childhood, indicate the existence of an intelligent Designer, who is thoroughly acquainted with all the secret springs of the human mind, and who has employed a wisdom truly divine, in the provision He has made for calling them forth, and exercising them.

EIGHTH WEEK—SUNDAY.

ON CHRISTIAN LOVE.

Charity, says an apostle, is the bond of perfectness, that strong and important tie, by which, among believers, heart is united to heart. The christian faith is no less remarkable in this respect, than in respect of what has been more emphatically called its peculiar doctrines, that it places the foundation of morality, as well as religion, on the principle of love. In the two preceding papers, I have adverted to the Providential

arrangements by which the affections of the heart, which constitute this principle, so far as it is naturally inherent in the mind, are called into action and cultivated. Let us now regard it as a religious duty.

I shall at present confine myself to the consideration of the love which we owe to our fellow-creatures, merely observing, with regard to this duty, as relates to the Author of our Being, and the Saviour of our souls, that it is the cultivation of that higher principle which gives to the social affection its most ennobling character; and, indeed, to speak more correctly, it is from love to God that love to man must flow, before it can deserve the name of a christian principle. God is our Creator, Preserver, and Governor; or, to state all in one word, our *Father;* we are therefore bound to each other by the endearing relation of brotherhood. Christ is our common Saviour; and this forms a new tie of a still closer and more tender kind. If, on the natural bond which unites the members of a family together, and thence extends to the great family of mankind, this more exalted principle be superinduced, a union will be formed which may well be called the cement of society. The love thus called forth, was so conspicuous for its strength and disinterestedness among the early followers of Jesus, as to excite the admiration and envy of their heathen neighbours, and gave rise to the well-known exclamation, 'Behold how these Christians love one another!'

The sentiment is of a similar nature among believers in the present day, though its intenseness is no longer exhibited by enduring the horrors of persecution, nor its highest exercise called forth by sympathy with common dangers and impending death. It is the union of a great family in love to one Father and Elder Brother, whence the mutual affection descends in the kindliest influences on the whole household. There is a remarkable figure by which an apostle illustrates the union thus formed; he represents christian society under the image of a human body, of which Christ is the head, and every individual believer is a member, and hence he infers, that 'we are members one of another;' that each member

has its own particular office assigned to it, which, if properly employed, is of benefit to all the rest; and that the whole 'being fitly joined together, and compacted,' forms 'a perfect man.' This beautifully shows forth and enforces the various offices of christian love. There are 'many members, yet but one body; and the eye cannot say to the hand I have no need of thee; nor, again, the head to the feet, I have no need of you; nay, much more, those members of the body, which seem to be more feeble, are necessary. God hath tempered the body together that there should be no schism; but that the members should have the same care one for another; that whether one member suffer, all the members suffer with it, or one member be honoured, all the members rejoice with it.'

A similar sentiment is expressed by our Saviour himself, when he says, 'A new commandment I give unto you, that ye love one another, as I have loved you, that ye also love one another.' There is a natural affection which men, as the descendants of a common parent, should entertain for each other; but here is a stronger bond formed between believers, by the love of Christ. It is a *new* commandment.

What a happy society would the christian world form, if that spirit of love were diffused over it, of which the great Founder of our faith exhibited so eminent an example. There are, indeed, many unavoidable evils of life, but how few and trifling are these, compared with the calamities which men bring on themselves by vicious indulgences, and especially by giving way to the malevolent passions. The winter may be stormy, but it is counterbalanced by the delights of spring, summer, and autumn. Disease may sometimes afflict us, but how small is the proportion of sickness to health. Loss of friends may distress us; but here religion comes with its consolations, and the Christian does not sorrow as others who have no hope. Though evil exist in the world, then, it does not naturally preponderate in the world; and, if we are unhappy, this must be owing either to the evil passions of our own hearts, or the malignity of others. Were we but to fulfil

towards each other the perfect law of love, even this presen sublunary state would be full of enjoyment.

It is surely superfluous to use many words, in order to show how necessary mutual love is to happiness. We need only look among our own acquaintances to be convinced that domestic harmony or discord is of more weight in the scale of social happiness or misery, than all other circumstances connected with our lot in this world taken together. Who can pass a single day without having the truth of Solomon's observation forcibly impressed on his mind, 'Better is a dinner of herbs, where love is, than a stalled ox, and hatred therewith.' Pleasures and pains of this kind, have a powerful tendency to diffuse themselves. A benevolent countenance sheds beams of joy on a whole circle, while a lowering and discontented brow brings gloom, and blights enjoyment. 'A greater punishment could not be inflicted on any rational being,' says Dr. Enfield, 'than that he should be rendered incapable of loving; nor can a more lively idea be formed of the wretchedness, as well as the depravity, of the prince of evil demons, than that suggested by the poet, when he makes him say,

"Evil, be thou my good."'

The converse of this sentiment is no less true, that there is no pleasure so great as that which arises from the cultivation of the affections. Of these, the highest of all are the religious; but it is of the benevolent that I at present speak. David was deeply sensible of this, and has beautifully expressed his feelings with regard to both. Speaking of the latter, he says, 'Behold how good and how pleasant a thing it is for brethren to dwell together in unity.' He compares it to the holy ointment with which Aaron was consecrated to the service of God, at once graceful and ennobling; and to the dew which descended on the mountains of Zion, sparkling with many colours, in the beams of the morning, and shedding refreshment and fertility around. Paul has equally extolled this virtue, in that celebrated passage in his Epistle to

the Corinthians, in which he describes it under the name of charity. His last characteristic of this principle is that which crowns the whole. It survives death, and is perfected in heaven. 'Charity never faileth; but whether there be prophecies, they shall fail; whether there be tongues, they shall cease; whether there be knowledge, it shall vanish away; for we know in part, and we prophesy in part; but when that which is perfect is come, then that which is in part shall be done away.' 'And now abideth faith, hope, charity,—these three; but the greatest of these is charity.'

Love is, indeed, the perfection of our being, and the source of our highest happiness. It is the very soul of angelic natures; and the cultivation of it on earth, is the best preparation for the heavenly society, when time shall be no more. The various arrangements, therefore, alluded to in former papers, by which the domestic and social affections are called forth and exercised, have a far higher ultimate object than that of binding society together, and contributing to our enjoyments in our present imperfect state. They have reference to eternity, and the faculties which they cultivate shall find their noblest exercise in heaven.

But the union of heart to heart, of which I have here spoken, is not attainable by fallen man, in his present state, without the infusion of a higher principle; and it is in the purification of his affections that the change induced on the mind by Divine grace, chiefly consists. The mere natural feeling, although one of the purest and most tender which inhabit the hearts of the race of Adam, is yet tainted and debased. It is the Holy Spirit restoring the image of God to the soul, which alone can ennoble it. Under His influences, friendships of earth are converted into a heavenly brotherhood, and, becoming divine, are rendered immortal.

EIGHTH WEEK—TUESDAY.

THE DIFFERENCE BETWEEN THE OPERATIONS OF REASON AND INSTINCT, AS AFFORDING ARGUMENTS IN FAVOUR OF THE DIVINE PERFECTIONS.

In turning, as we are now about to do, to the effects produced by the exercise of the rational faculties of man, in aiding the productive powers impressed on nature, it will be necessary to attend to some circumstances, which serve, in a certain degree, to give a new character to our reasoning. The instincts by which the lower animals perform the important offices necessary for the production and rearing of their young, are obviously contrivances with which they have nothing to do, further than to execute a task assigned to them by a Superior Power.. It is clear that there is a great end to be attained, that they perform certain actions necessary for the attainment of that end, and yet that they are altogether unconscious of the part which they are acting, and even entirely ignorant of the end itself; and it hence follows, that every movement which they make, tending to the preservation of their species, comes irresistibly home to our understandings, as a proof of wise intention, not in themselves, but in the Unseen Author of their nature. Thus, when the bird builds its curious nest, and, having deposited its eggs, patiently broods upon them for the appointed time; and then, after the fostering warmth of her body has produced the callow young, when she tenderly watches over them, catering for them with the most assiduous toil, and teaching them to flutter their little wings, to sport in the liquid air, and to forage for themselves; in all this, it is impossible not to perceive, that, by whatever second causes such instincts are prompted, they can be no other than the original ordination of Creative Intelligence.

It is different, however, with the labours of man. He too, indeed, has his instinctive propensities, some of which have

for their object the production and preservation of the species; while they lead, as we have seen, by necessary consequences, to important results, which he neither contrived nor anticipated; and, thus far, the argument is the same for him as for the brutes. But he is also endowed with rational powers, in virtue of which he speculates on the future, and, pursuing the conclusions of his own mind, lays plans on which he acts, and bends the powers of nature to his will. It is in this way that he proceeds in his agricultural schemes and employments. They are the fruit of his own skill. He has reasoned on the properties and functions of the soil, and of its vegetable productions, and on the vicissitudes and the genial powers of the climate; he has profited by his own experience, and that of others; and thus he converts the barren waste into a fruitful field, and causes the desert to blossom as the rose. There is here something altogether different from instinct; and, in looking for the hand of the Creator, we find another, and seemingly independent, intelligence at work, which interrupts our view, and causes us to consider the matter more deeply. We have, however, but to turn back a single step. Who endowed man with his rational faculties? Who so contrived the soil, and the vegetable world, and even the seasons themselves, as to be subservient to the use of man, and under the control of these rational faculties? Undoubtedly the same Eternal Being who bestowed on the rest of the living world their instincts. Every thing, therefore, resolves itself ultimately into the appointment of Creative Wisdom.

But, besides this original creation, there is a superintending Providence, which guides, controls, and overrules all events, so as to render that in reality a providential occurrence, which appears, at first sight, to be the mere result of human ingenuity. Look, for example, at the invention of the steam-engine, which has caused, and is now causing, so great a revolution in human affairs, by bestowing on man such extraordinary powers. It was the Creator who endowed steam with the amazing expansive force which it possesses, and with the quality of instant condensation by cold. It is true, that

these properties remained long unemployed,—that for many ages the steam poured uselessly from the tea-kettle and the caldron, and, though so familiar to man, was passed by without a suspicion of the benefits it was capable of conferring. But the powers were *there*, ready to be used when the progress of society demanded their aid; and the human faculties were, meanwhile, undergoing a discipline and a training, which sharpened their ingenuity, and added activity and enterprise to skill; knowledge accumulated, human wants increased, commerce extended, manufactures rose in importance. It was *then* that a force was required, which might give new energy to human exertions, and proportion them to the growing demands of society. This was sought for, and found to be at hand. Is any one so sceptical as to deny, that, though the steam-engine be the result of human contrivance, steam itself received from its Creator its extraordinary qualities, for the express purpose of becoming thus, at the proper period, subservient to the wants of man?

And what is human contrivance? Is it not the result of faculties impressed on the mind by the hand of the Eternal, and brought to maturity by the various adaptations, incitements, and suggestions of His providential arrangements? In every way, then, the invention in question may be traced, by a devout mind, to the Supreme Being, as its final cause.

Now, this is but an example of the operations of Providence, as they regard the rational creature. The believer sees the Divine Hand everywhere, and the light which is thus thrown on the operations of Nature, in connexion with human reason, is most wonderful and edifying.

But, although this view is altogether satisfactory to a mind already, by other evidence, convinced of the being and perfections of the Infinite Creator, I am by no means sure that the same train of reasoning can be brought to bear against the prejudices of the infidel, with a force at all equal to that which overpowers him in contemplating the blind, and yet intelligent and admirably contrived, operations of instinct. Here the intelligence and contrivance, as I have said, being,

obviously, not in the animal itself, force us to look up to the unseen Creator; but, with regard to the actions of rational creatures, it is much easier to rest in the second cause. An objector may say, 'I see, in the human faculties, sufficient power and intelligence for the production of such a piece of mechanism, or for the contrivance of such an improvement; —on the one hand are the materials, and on the other are the results of his ingenuity in operating upon them. I rest here, and see no reason to go farther.' When we are opposed by such an objection as this, we are thrown back upon the independent arguments from which Creative Wisdom, and a Superintending Providence are adduced; and, convincing as the reasoning is to ourselves, we feel that it is not suited to such a frame of mind as that of our opponent.

In speaking, then, of agricultural improvements produced by human ingenuity, the only argument we can hold with the atheist is this,—that there is an astonishing and obviously intended adaptation, in natural objects, to human wants, and to the powers and faculties of the human mind. The one is, in every respect, suited to the other; and in that suitableness there is creative contrivance. To this extent, at least, the infidel may be met upon his own ground.

EIGHTH WEEK—TUESDAY.

ORIGIN OF AGRICULTURAL LABOUR.

That every thing is made for the use of man, is a sentiment not more proud and exclusive, than it is false; if, by this expression, be meant, that *his* advantage and enjoyment alone have been consulted in the formation of the world. But though the Creator, doubtless, regarded the welfare ofeach class of his creatures, when he called them into existence, and in this view they may be justly said to be created for their own sakes, yet He has so united all these classes together, as to form one great and harmonious whole, and, by most wonder

ful adaptations, has so beautifully adjusted all the relations, both of the animate and inanimate world, that every thing may, in a certain sense, be said to be created for all the rest. In this sense, the observation applies, with peculiar force, to man, the only rational being in this sublunary creation. Let us thus regard the various phenomena of Spring.

The general aspect of Nature, we have already noticed as a source of delight to the mind of man. The miraculous power, which, at this season of the year, seems everywhere to be exerted to call a dead world into life and beauty,—in the vegetable kingdom, the shooting of the tender blade, the expanding of the buds and leaves, the opening of the blossoms, —and in the animal kingdom, the variety of forms that are seen on every hand springing into life and enjoyment, with the instinctive habits and functions by which the different tribes are preserved and nourished,—while they afford a deep interest to the taste, furnish a never-failing subject for the exercise of the rational powers, and for the cultivation of the devout affections.

But there are active duties, also, which this pleasing season imposes on the human race, arising from that early sentence of the Creator, which included at once a denunciation, a permission, and a command, 'In the sweat of thy face shalt thou eat bread, till thou return to the ground.' It has been justly said, that all the riches of the world arise from its vegetable soil, which forms the original nourishment of animal existence. But the soil may be improved by cultivation, and hence the utility of labour. Did it bring forth, indeed, spontaneously, all that was necessary for human subsistence, it would neither require nor receive that aid which is now bestowed on it by the skill of man. It is sheer necessity which first calls forth those exertions, whereby the curse is mitigated, and crops of useful grain are made to wave on the surface of the earth, instead of 'thorns and thistles.' The process is plain by which this necessity is created, and it argues, in no slight degree, the exercise of designing Wisdom. In a wilderness untouched by the plastic hand of man, the general state

of vegetation stands thus:—there is a vast profusion of grass and other succulent herbs, along with numerous seeds and fruits, fit for the use of the lower animals, who are incapable of agricultural labour,—'who neither sow nor reap, nor gather into barns.' These, as our Lord beautifully remarks of the fowls of the air, are fed by our common Father; but, among that bountiful provision for them, there are comparatively few plants of spontaneous growth, on which man can subsist. There is nearly everywhere a sprinkling, as it may be called, of fruits and seeds, which he can use for food, but nothing more;—enough to afford nourishment to a few scattered families, but not enough for a numerous population. Exercise is necessary for the health, both of his corporeal and mental powers, and his native indolence must be roused by necessity. The scantiness of his natural food is, therefore, a wise provision, suited to the constitution of his fallen nature, and which cannot be too much admired.

To show its beneficial operation, I must mention another principle, which is common to man with the inferior creation,—the tendency to propagate the species up to and beyond the means of subsistence. This occasions want; and want stimulates industry and ingenuity. A few words will illustrate this. Suppose a pair of the human race thrown on a desert island, and entirely cut off from the rest of the world. They would probably find, in the fruits of the trees, the seeds of plants, and the animals which fell into their power, the means of immediate subsistence. They would produce a family, however, and these would propagate again, till, in process of time, the spontaneous growth of the island would begin to be exhausted. But before this period had actually arrived, it would be anticipated; and their ingenuity would be called into exercise, to increase the means of subsistence. They would invent instruments for entrapping or killing the wild animals with which their place of residence was stored, or for drawing the fish from the sea with which it was surrounded. The first rudiments of agriculture would also be commenced. Fruit-trees would be planted near their dwell-

ings; and small patches of ground would be dug, in which some useful plants would be cultivated. These latter operations suppose the invention and formation of some rude instruments of agriculture.

But, at length, these labours would begin to fail of producing sufficient food; and what was begun merely as an exercise of ingenuity, or an arrangement of convenience, would come to be followed, at first, as a profitable, and afterwards as a necessary, employment. Still the population would continue to increase. A constant demand would thus be made on the inventive faculties and the active powers. New and better constructed instruments would be formed for turning up and pulverizing the soil; greater and greater portions of land would be taken into cultivation, first in the open valleys, and then by encroachments on the woods and mountains. Manure would be applied; better modes of agriculture would be suggested by experience, and eagerly adopted; fresh species of plants, fit for food, would be sought for, and propagated; land would be drained, and swamps cleared. Meanwhile, animals might be discovered fit for the use of man, which it would be convenient to have always at hand, instead of seeking for them in their native haunts. The young of these would be brought home and tamed; and thus flocks and herds might become part of the possessions of this increasing population.

This rapid sketch, imperfect though it be, may serve to show the wise providential arrangement by which man is stimulated to industry, and his mental faculties are exercised. The comparatively scanty provision made for his subsistence in the natural state of the vegetable kingdom, and the power which belongs to him of increasing that provision in proportion to his wants while these wants accumulate upon him as the population becomes more numerous, are some of the most powerful means ordained by the Creator, for rousing his active powers and urging forward the progress of society; and thus we observe a very remarkable proof of intelligent and benevolent adaptation between the human faculties and the state of the external world.

EIGHTH WEEK—WEDNESDAY.

ORIGIN OF PROPERTY IN THE SOIL, AND THE DIVISION OF RANKS.

The necessity of labour in propagating the fruits of the earth, gives rise to a division of property in the soil. For the sake of simplifying the subject, we yesterday supposed a pair placed in an unknown island, and thus limited in the extent of territory from which they and their progeny could draw the means of subsistence.—But this supposition is by no means necessary; for such is the expansive power of the principle of reproduction in man, that, although placed in the wide world, with all the fertility of a tropical region to call forth the produce of the earth, the species would soon be multiplied beyond the means of comfortable subsistence, without the use of artificial resources. Abundance defeats itself. Such is the power of increase, that just in proportion to the means of subsistence, the population is rapidly filled up, and labour becomes necessary for increasing the supply.

'Let us suppose,' says Bishop Sumner, 'a couple in the situation of the first created man and woman, having the world all open before them. Here the idea of scarcity seems entirely precluded. Let them take possession of a district, consisting of 200,000 acres, which, according to the average power and cultivation of land in Great Britain, would support 100,000 persons.* Reckon twelve persons at the end of the first twenty years; who, under such favourable circumstances, would certainly, taking one period with another, multiply according to the quickest known increase of the species, and double their number every fifteen years.† Within a hundred and forty years from the creation, these twelve persons would have about 3000 descendants, which, in sixty years more, would ascend to 49,152. One generation farther

* Wayland on Poor Laws, p. 273.

† This is the rate in the back settlements of America. Sir William Petty supposes a doubling possible in so short a time as ten years.—*Malthus*, i. 7.

would give us 98,304 persons, and carries us already as far as the point to which population can possibly go, the point of subsistence.'*

At this point, the natural relief would be found in emigration; but our author justly observes, that before men consented to leave the spot of their nativity, and to try their fortune by fresh cultivation, they would certainly argue, that what could not be possessed without a sacrifice, or obtained without labour, must belong to each person according to the labour he was able or willing to employ. At all events, this would be the case where emigration was difficult, or cut the new settlers off from free intercourse with the rest of the population. Perhaps, indeed, if bodily strength, mental ability, and industrious habits, were the same in each individual, and there were no difference in the amount of labour capable of being bestowed by each family, men might, under the circumstances I have mentioned, be induced to labour for a long time in common, and thus the division of property might be indefinitely retarded. But this is very far from being the case. In all the particulars I have detailed, one man differs materially from another. A sense of justice would therefore very soon suggest the propriety of an appropriation of the soil which had been cultivated by each family. They had bestowed a certain degree of labour and ingenuity upon that particular spot;—if more than others, it was reasonable that they should reap the fruit of their superior exertions; if less, it was unfair that their indolence or incapacity should cause others to suffer.

Here, then, is laid the foundation for a division of property in land, which is a sure, and indeed a necessary, step in the progress of agriculture. As long as men earn their subsistence by fishing or the chase, the division of property is neither so rapid nor so complete. These operations are best conducted by the combined labours of many, and the difference of bodily or mental powers may not perhaps be so directly felt to be a disadvantage; because, while the most active and

* Sumner on Creation, vol. ii. pp. 109, 110.

intelligent would naturally take the lead, there would be, in the various requisites of the combined efforts, a place to which the qualifications of almost every individual might be found suitable. What has been acquired by the united labours of a tribe, seems naturally to require equal distribution; and it will not be thought surprising, or contradictory of the observations already made, that, under these circumstances, some rude communities should exist, even in the present advanced state of the world, which still preserve their goods in communion, and have no accurate ideas of individual property. But this is never the case where agriculture has made any considerable advances. There the relative value of talent and industry, as well as of a numerous family, is easily appreciated; and hence the desire of appropriation.

A division of ranks naturally, and indeed necessarily, follows a division of property. Suppose the process begun, and it is easy to follow it out to this result. 'One man, whose strength and vigour enable him to prosecute his work unremittingly, prospers in his undertaking, and reclaims a quantity of land, not only sufficient to supply his own wants, but to afford an overplus. Even if his family increases, his children, as they grow up, add so much labour to the common stock, that the surplus above all their wants increases gradually with their strength and skill, till they are enabled to support a second family in addition to their own. In the natural course of things, however, others must prove less fortunate. One is cut off by sickness, and leaves his children dependant on the care of friends. Another is deprived, by some accident, of power to use his tools, till the season of cropping the ground is past. It follows that he must be fed by the more successful labour of his companions. But besides the operation of casualties, the effects of moral and mental distinctions must be taken into account. Some would be skilful and industrious, others the reverse. The one class would acquire what the others abandoned. The one would become rich and prosperous, while the other would become poor and dependant.

By these means a foundation would be laid for the distinction of society into employers and employed. The successful would increase in their desire for comforts and conveniences, as they increased in wealth; and commerce, taking its rise from this desire, would furnish them with the means of gratification. Hence would flow a demand for additional agricultural labour. Larger profits, and therefore more extended property, would be sought for. But the industry of a single family is necessarily limited; and, in order to cultivate a larger farm, the aid of others would be sought for. This aid would be found from among the poor and dependant class, who would readily be induced to give their labour for the means of subsistence. Here we find, by an obvious and inevitable process, the distinction of ranks established. Examples of this process are constantly to be found in the history of the early stages of society. A striking instance of this occurs in Roman history. Not only were the inhabitants of Rome reduced to an equality by an Agrarian law, which awarded an equal division of territory to each individual, but such laws were enacted by Romulus and his successors, as tended to perpetuate this equality as far as human regulations could restrain the natural current of events. Yet this unnatural state of things was of short duration. 'The course of human affairs,' says Adam Smith, 'by marriage, by succession, and by alienation, necessarily deranged this original division, and threw the lands, which had been allotted for the maintenance of many different families, into the possession of a single person.'* This was the case with many other of the ancient republics, where similar laws were established. The natural tendency to inequality broke through all the restraints of human arrangements, and, in spite of them, produced those salutary distinctions on which the fabric of society is reared.

'The Deity has provided,' says Sumner, 'that, by the operation of an instinctive principle in our nature, the human race should be uniformly brought into a station in which they are forced to exert and to improve their powers; the lowest

* Smith's Wealth of Nations, vol. ii.

rank to obtain support, the one next in order to escape from the difficulties immediately beneath it; and all the classes upwards, either to keep their level, while they are pressed on each side by rival industry, or to raise themselves above the standard of their birth by useful exertions of their activity, or by successful cultivation of their natural powers. If, indeed, it were possible, that the stimulus arising from this principle were suddenly removed, it is not easy to determine what life would be, except a dreary blank, or the world, except an uncultivated waste.'*

EIGHTH WEEK—THURSDAY.

EFFECTS OF PROPERTY IN THE SOIL.

THERE are some social arrangements so intimately connected with the moral constitution of man, that they invariably attend the progress of civilization, being at once the natural effect of that progress, and a necessary step to further advancement. Of these, none perhaps is more remarkable than the acquisition of property in the soil. I have already shortly adverted to the principles of our nature, which lead to this appropriation.† What I have to remark at present is, that, without this propensity to take possession of the soil, accompanied as it is by a natural feeling which concedes the right of possession to him who has actually obtained it, man must, in all probability, have remained in a rude and unimproved state, and the earth uncultivated and waste, would have denied the abundant harvests, on which not merely the prosperity, but the very existence, of civilized society depends.

As soon as the soil has begun to be cultivated, it becomes, as I have stated, by that very operation, the property of indi

* Sumner on Creation, vol. ii. p. 132.

† If the reader desires to prosecute this inquiry, he would do well to consult Dr. Chalmers' Bridgewater Treatise, chap. vi. 'On those special affections which conduce to the civil and political well-being of society.'

viduals; because the pains which have been bestowed by these individuals in preparing it, stamp a certain value on it which it did not previously possess. It has, by their industry, been cleared of bushes, roots, and other incumbrances, perhaps freed of its superfluous moisture by draining, and defended from encroachment by enclosure. All these circumstances, not to mention the single circumstance of occupation, which is itself sufficient, constitute a right to the soil felt by the individual, and respected by neighbours. On this principle the law of property is founded, and that law forms the strong bond of society, and may be said to be the starting point for the prosperity of nations. It is by the operation of this law, that agriculture is converted into a regular system, and becomes an art of such essential importance to the welfare of society. Were it not for the appropriation and subdivision of the land, the whole face of the country would remain nearly in its natural condition—as is still the case among those savage tribes where civilization has not yet penetrated—and the means of support for human beings would have been comparatively scanty. Among some tribes of North American Indians, and in various parts of Africa, and especially among the aborigines of Australia, the effects of this state of things are obvious. The human inhabitants, ignorant and barbarous, are thinly scattered over large extents of country, which are naturally fertile perhaps, but almost destitute of vegetable productions fit for the use of man. Pulse of every species is rare; there are few esculent roots, and no grain. Contrast with this, the appearance and resources of such parts of these very regions as have become the habitation of civilized man. There the land, having become private property, has been subjected to the transforming influence of cultivation, and instead of yielding food almost exclusively for the inferior creation, has become a granary for the support of rational beings; the consequence of which is, that while the human species, living in abundance, and cultivating the peaceful arts, are rapidly increased in numbers, and improved in their intellectual powers, the very beasts of the field receive importan

benefits, from what might, in one view, be considered as an usurpation on their native domain.

A still more striking evidence, perhaps, of the salutary effect produced by the appropriation and consequent cultivation of the soil, may be found by seeking for it in those countries which formed the early seat of agriculture, but have since been abandoned through the agency of a grinding despotism. The whole extent of the Turkish dominions, especially in Asia, at this day, exhibits a melancholy and instructive example of this kind.*

Now, the lesson which I am anxious to inculcate on my readers from all this detail, is, that there is a remarkable correspondence between the constitution of external nature in these respects, and the moral constitution of man, exhibiting the clearest indications of beneficent design in Him who is the author of both. If the earth requires to be cultivated, before it gives forth its supplies, in great abundance, for human support, there are principles in the mind of man, which are obviously intended to inspire him with a predilection for agricultural employments, which protect and encourage him in the exercise of these employments, and which render that exercise not less salutary to his moral and intellectual faculties, than it is invigorating to the powers of his body. Or, to take the converse of the proposition, if man is naturally endowed with mental qualities, which require to be roused by difficulties, and called into vigorous action by some powerful necessity, then the state of external nature, in reference to the produce of the soil, is precisely such as to present these very difficulties, and to stimulate the mind with a sense of that very necessity. In whichever way we view the subject, it is impossible not to perceive, that a wise Creator has adapted man to his circumstances, and these circumstances to the benefit of man.

* Keith on Fulfilled Prophecy.

EIGHTH WEEK—FRIDAY.

BENEFITS DERIVED FROM THE PRINCIPLES WHICH STIMULATE AGRICULTURAL IMPROVEMENT.

THERE can be no doubt, that in the progress of society, the principle of which we have been considering, a vast change takes place in the various relations of life; but it has been a matter of dispute, how far that change has, upon the whole, been salutary; or, at least, whether or not it will, in the last result, prove to be so. It has been alleged, that, 'if the rapid multiplication of the species augments the treasures of civilized society, it also entails upon civilization a certain inheritance of want, and pain, and misery, and that the human race are little benefited by arts and improvements, which are wrung from them by the urgency of their necessities; that, however plain it may be made, that the means employed accomplish their apparent object, still it is by a mode so harsh and ungentle in its operation, that the wisdom of the Creator is impeached, rather than displayed, when the intricate web of human society is thus unfolded, and its texture unravelled.'

That the reader may be furnished with a proper answer to these plausible objections, he must keep steadily in view the principles already laid down for judging of the operations of Providence. This world is not a state of happiness, but of discipline; both its moral and physical condition is fallen and debased, by the alienation of man from his Creator. All its adaptations, contrivances, and processes, must therefore be viewed with reference to this state. We are not to look for perfection, but for plans and operations, suited to lead a fallen and guilty creature to the attainment of it—not for a full development of the Creator's designs, but a partial view of the commencement of an amazing scheme, which has eternity for its theatre of action.

'If we were peopling an Utopia,' says Bishop Sumner, 'or amusing our fancy, after the manner of the ancient philoso-

phers, with creating an imaginary republic, we should undoubtedly be inclined to banish from it all necessity for severe labour. We should omit the curse denounced upon the first transgressors, and literally fulfilled upon their posterity, ordaining that the earth should bring forth thorns and thistles, and that man should eat bread by the sweat of his brow. But these sports of imagination deviate from the real state of things in one most important particular. They all suppose, that this world is the final object, as well as the limit, of man's existence.'

However beautiful such views might be, as they do not exhibit the condition of man in his present state, they ought not to be taken as the rule by which we judge of the adaptation of the material world. Taking man as he is, I have already shown how a state of labour—of even severe coercion to labour—is suited to call into action his latent faculties. I am far from pretending to say, that no evils accompany the law which binds him to this state. I know, on the contrary, that there are numerous evils arising from the wealth, as well as the poverty, to which it gives rise. But then these evils are much more than compensated by the advantages which flow from the system. It is not difficult to suppose a state of things in which plenty should constantly attend the human race, however numerous they might become, or in which the numbers of mankind should be always, without any restraint or privation on their part, exactly proportioned to the means of subsistence. But, on either of these suppositions, the stimulus to exertion would be gone ; and that indolence, which belongs to the species, and is only removed by necessity, would repress and overpower the human faculties.*

It is as possible to picture to the imagination a race of men, who should require no stimulus to the exercise of their minds and powers, as it is to conceive a soil that should be fertile without cultivation. But our business is with the world as it exists, and with men as we find them ; and, judging accord-

* Bishop Sumner refers to Humboldt, and other travellers, for proofs of this deterioration among the indigenous inhabitants of North America.

ing to that experience, we may affirm, without hesitation, that any ordinance which would establish universal plenty, would establish also universal indolence, and not only arrest civilization in its progress, but force it to retrograde, if it had once advanced. There is reason to believe, that this effect has in some peculiar circumstances, actually taken place, when a few tribes, having left their parent and overpeopled country, and found an unexpected plenty in some new abode, have lived upon that plenty, till they have lost the arts of their ancestors, and left their posterity to work out anew, by the slow method of invention, the means of supplying wants or providing comforts.* How soon rude inventions may be lost, when the necessity which first struck them out is removed, may be learned from the example of the South Sea Islanders, some of whom are now in greater distress from the precarious supply of iron they depend upon, than, before the visits of the Europeans, they had experienced from the total want of it. Be this, however, as it may, it is certain that the effect of plenty on savage nations is indolence and extravagance, till the supply that brought the evil is exhausted, and activity returns with the necessity for its exertion.

'All mankind, as far as we know, agree in the same properties by nature, and owe their infinite varieties only to the circumstances of society. We have no right, therefore, to as-

* Proofs of the natural indolence of the human species might be multiplied to any extent. A single example may be taken from the inhabitants of one of the South Sea Islands, as mentioned by Mr. Ellis. The Otaheitans, whose country, from various known circumstances, which I need not stop to mention, is not at present peopled up to its natural resources, refuse to cultivate the valuable arrow-root, because it costs them some trouble in rendering it fit for food. Their yam, also, 'a most valuable root, is cultivated to no very great extent, from the labour and attention it requires, although it is one of the best flavoured and most nutritive roots.' 'When they were exhorted to adopt the comforts of Europeans, they answered—"We should like these things very well, but we cannot have them without working: *that* we do not like, and therefore would rather do without them. The bananas and plantains ripen on the trees: the pigs fatten on the fruits that fall beneath them. These are all we want. Why, therefore, should we work?" '—Ellis' *Polynesian Researches*, vol. i. pp. 360, 541.

sume, that the consequences of plenty would be different in America and in Europe; or that, if the necessity which has produced all the multiplied inventions and ornaments of civilized life were once removed, the faculty to suggest them would be fostered, or the industry to perfect them survived. But who would be so visionary as to affirm, that the comfort of society would be benefited by a system, which excluded all the useful and ingenious arts; or the general good of mankind promoted by the extinction of all the liberal professions, —the absence of all science and literature? Independence would be dearly purchased at the expense of refinement and cultivation; and universal plenty would afford a poor compensation for the gross ignorance into which mankind would be plunged.'*

EIGHTH WEEK—SATURDAY.

THE BLESSINGS OF LABOUR.†

INDEPENDENTLY of the declarations of Scripture, a moment's serious reflection is sufficient to convince us of the admirable and merciful adaptation of the laws of the earth's productiveness to the moral and intellectual state of man. Were the sky ever serene, and the air ever warm and genial; were the fierce extremes of heat and cold unknown; and were every species of fruit spontaneously scattered over the earth, in exhaustless profusion, the physical wants of our race might be adequately supplied, and the world might be peopled with millions of human beings, enjoying in abundance the means

* Sumner on Creation, vol. ii. pp. 146, 147.

† These additional observations on the paternal kindness of those providential arrangements by which laborious exertion is rendered necessary to man, in procuring the means of subsistence, are furnished by the ingenious friend, to whom I am indebted for several other papers with the same signature. Some of the views already stated, will be here found repeated in a new train of thought. They will not, however, be felt to be misplaced; and they are too important to render such a repetition unedifying.

of appeasing their hunger and thirst. And were these beings possessed of a sinless nature, they might, indeed, consecrate their calm and undistracted days to the high pursuits of science and religion, and might attain to heights of contemplation and social joy hitherto wholly unexperienced. But let us only consider the moral state of the race with which the earth is at present peopled, their evil passions, their love of inaction, and the corrupting tendency of indolence,—and we shall learn to prize and bless that arrangement by which labour is made the condition of subsistence, and all true enjoyment. Were the pressing wants of man supplied without cost or industry, what motive could prompt him to exertion, and raise him above the condition of the brutes? His food being plentifully supplied him, and clothing and shelter being almost unnecessary, would he not be contented to pass his life in slothful inactivity, or in wanton acts of mischief and violence? Indeed, seeing it is the present tendency of ease and luxury, even though checked by the most powerful religious and social restraints, to generate a spirit of selfishness and moral abandonment, may we not conclude that man, if labour and all its consequences were unknown, would only revel in the grossest indulgence, forget the Hand that fed him, and feel no desire to cultivate the moral and intellectual capacities of his nature?

In countries where a rich soil and a powerful tropical climate produce almost spontaneously the means of subsistence, civilization, and all the refining arts of life, are in the lowest condition. Man is there unacquainted with peaceful industry, and but too frequently seeks plunder or excitement in war or the chase, or, at best, resigns himself to a savage indolence. In countries, again, where nature is less exuberant, where the soil requires cultivation to enable it to support its possessors, and the climate renders artificial shelter and clothing a necessary of life, society readily flourishes, and agriculture and the useful arts give birth to commerce with all its blessings. There spring up literature, science, and the various branches of civil polity, the last and best results of human

labour. Thus, in Europe, and in several of the more temperate regions of Asia, has our race made the greatest progress in the career of social improvement. There have been achieved the mightiest deeds in the pursuits of war and peace; for there they have been driven into industry. They have become the noblest portion of mankind, because they have been constrained to be the most laborious.

To what but the necessity of procuring shelter and subsistence, do the arts of life, under Divine Providence, owe their origin? What else gave rise to agriculture, and all its subsidiary arts?—induced man to sink the mine, and to fuse and fashion the precious metals?—produced the daring efforts of architecture, and the beauteous wonders of the loom? What but the cravings of his physical wants prompted him to cross the dangerous deep, and effect an interchange of products between the most distant lands? But for these wants, he would have been content to vegetate upon his native spot, local attachment prevailing over the promptings of curiosity itself. The sea, therefore, the best highway between remote countries, would have remained untraversed; and the earth's utmost shores would only have been visited slowly, and after the lapse of ages, by tribes of men gradually propelled from the original centre of population. Thus, the advantages of navigation and commerce would have been altogether unknown. Had not labour been imposed upon man, how could those sciences have arisen that give him such a mastery over brute matter, and reveal to him so many secrets of Nature? Without the glass that he employs to admit the light into his roofed abode, fashioned by his skill into the prism, how could he have unravelled the solar beam, and explained the brilliant phenomena of colour? Or, without that same beautiful result of his labour, taking under his plastic hand another form, where would have been that sublime astronomy which unveils to him the glories of the universe, and exalts him, as it were, above his natural destiny?

Such are the thoughts that occur at this busy season, when the farmer and his labourers are so actively engaged in pre-

paring the soil, and committing to it the precious seed. All the land is now ringing with the sound of rustic toil. The sower follows hard upon the ploughman, and is, in his turn, closely approached by the harrower. The carefully hoarded manure is carried out in carts and waggons, and scattered over the fields, where, by the kind agencies of Nature, it is destined to increase tenfold the treasures of the coming harvest. Severe and unremitting are the fatigues of the husbandman and daily labourer, engaged as they are in a continual warfare with the sturbbornness of the soil, and the various inclemencies of the season. But the sweat wrung from their brow sweetens their enjoyments; after labour, comes to them the luxury of rest; and health and cheerfulness are among the fruits of their hardy occupations. They find a pleasure in active employment; so that spring and harvest, when their labours are most continued and severe, are the seasons of their highest excitement. Even to those who are not dependant for support on the work of their hands, the spectacle of the present agricultural operations must surely be highly animating. For, can it fail to occur, that on these depends the future support of the rich and the poor, and that, indeed, on agriculture is based the entire fabric of human civilization? And when we behold the sons of labour plying their vocations in the field, whether or not it be our lot to mingle in their toil, can we fail to admire the wide expanse of valley and plain, smiling with green blades or ripened ears, the rich reward of their diligence, and to reflect that, but for cultivation and it's cares, the country would be a pestilential forest or marsh,—the extremes of heat and cold would be fatally severe,—and, a still greater evil, man would be plunged in ignorance and sloth, if not also pinched by a scanty and precarious subsistence? We are thus forced to exclaim, with the bard of the Seasons,—

> 'These are thy blessings, Industry! rough power!
> Whom labour still attends, and sweat and pain;
> Yet the kind source of every gentle art,
> And all the soft civility of life.'

Even in his state of innocence, man was not without his abour. Adam had assiduously to cultivate his happy and beautiful abode; which shows that his Creator formed him for action as well as contemplation, and that industry was essential to his highest happiness. In the emphatic words of our great poet,—

> 'Man hath his daily work of body or mind
> Appointed, which declares his dignity,
> And the regard of Heaven on all his ways.'

J. D.

NINTH WEEK—SUNDAY.

SPIRITUAL TRAINING BY AFFLICTION.

The principle, as we have seen, by which we are so remarkably urged forward in the path of improvement, is privation. This implies suffering; and, in fact, the fear of suffering on the one hand, and the hope of enjoyment on the other, are two of the strongest motives of human conduct. Such is obviously not a state of perfection, but of discipline; and every thing, in the various providential arrangements of the world, strikingly corresponds to this condition. We are under training for eternity; and this is the important view in which we are taught, by the Gospel, to consider all the events of life. While we painfully labour for the food which perishes, we are reminded by the voice of Revelation, that there is a food which endures to everlasting life, for the attainment of which, we ought, above all things, to exert our rational powers. To lead us on this path of duty, Divine Providence is constantly employed. Hence God is very frequently represented in Scripture under the character of a Father and Instructor. We hear of his rod of correction; of his profitable chastisements; of the heart being made better by the sadness of the countenance. The same thing is taught when Christ

is exhibited to us under the character of a physician. He gives us bitter medicine, that he may cure us. He probes the wound, that he may heal it.

It is delightful to dwell on this view of our God and Saviour. Nothing can be more endearing than the assurance that we are the objects of his constant regard,—that he numbers the hairs of our head, and counts our tears, and that all things are working together for our good. What a different character do privation and suffering assume when viewed in this light. From curses they are converted into blessings. When we think of 'the light affliction of the present moment, working out a far more exceeding, even an eternal weight of glory,' we cease to complain,—we learn even to rejoice in our afflictions. It was this which sustained the apostles, the martyrs, and the confessors of our holy religion, —which made them 'more than conquerors,' and which enabled them triumphantly to exclaim,—'We are troubled on every side, yet not distressed; we are perplexed, but not in despair; persecuted, but not forsaken; cast down, but not destroyed:' 'Neither death, nor life, nor angels, nor principalities, nor powers, nor things present, nor things to come, shall be able to separate us from the love of God which is in Christ Jesus our Lord.'

But this view is not less instructive than it is delightful. Is God our Father? Then, if He teaches, we must learn: if He gives warning, we must listen: if He chastises, we must be corrected. Is He our physician? Then, if He administers medicine, however bitter and nauseous, ought we not cheerfully to drink the cup to the very dregs? If, to heal us, he probes our wounds to the quick, ought we not, without shrinking,—nay, thankfully, to submit?

The afflictions to which the providence of God is pleased to subject us in this sublunary state, are various and severe. He at one time tries us by withdrawing some cherished enjoyment; at another, by inflicting some positive suffering. Our hopes may be disappointed; our worldly affairs may become embarrassed; our friends may prove unfaithful; our

children undutiful or profligate; sickness may invade the family circle; death may sever the dearest ties which bind us to life. These are distressing dispensations; but who will say that, if received in a right spirit, they are not salutary? Alas! we make idols to ourselves of earthly things; prosperity withdraws our hearts from God; and is it not well that He should deprive us of that which betrays us? What if it were otherwise?—if God, in just indignation, ceased to chastise us?—if the sentence pronounced upon Ephraim were uttered against us, 'They are joined to their idols, let them alone?' But it is not so. God still trains us as his children; when we are afflicted, it is the hand of a Father which corrects us. When he hides his face, it is in mercy. He waits to be gracious.

God deals with us in spiritual, as He does in temporal things; and here, too, his mode of acting is frequently beyond our power to unravel. He bestows and withholds the blessings of his grace, often in a manner, and for reasons, that baffle human judgment. In all his actings, He is, doubtless, guided by unerring wisdom and goodness; but to us it appears as if the sunshine and the cloud in the spiritual atmosphere, were as fitful and capricious as seem to be the analogous changes in the natural atmosphere. Both are regulated by a will, which, on account of its infinite superiority to ours, we cannot follow in all its plans; but which never fails to effect the most beneficent purposes. When the snow lies on the ground, and all things wear the aspect of desolation and death, the germs of future vegetation are preparing to be unfolded, and the insect race are lying cradled in their snug retreats, to rise to life in the genial heat of returning spring. In the advancing year, when, at times, the smiles of a warmer sun are withdrawn, and the fair face of day is shrouded in clouds and tempests, there is still a secret hand at work, 'staying the rough wind in the day of the east wind,' and leading the seasons onward in their steady course. And so it is with the operations of divine grace. The light of religion may seem to be withdrawn, for ages, from whole districts and

countries, nay, almost from the world, and a cold and cheerless winter may appear to envelope all; yet still the germ of life is there, and life itself. In times of Israel's greatest defection, when the prophet thought he stood alone in his faithfulness, God re-assured him with the declaration, that he had yet reserved to himself, in that apparently dark and lifeless land, seven thousand persons who had not bowed the knee to Baal. Again, when the light of the Gospel has begun to shine brightly on a favoured spot, and the spring of a spiritual year seems to be vivifying the divine seed far and wide, and causing a dead soil to start into life and beauty, there often comes a fierce and chilling blast, which appears to bring back gloom, blight, and ruin, to an awakening world. But here, too, there is mercy mingled with judgment; the warmth, which seems to have abandoned the atmosphere, still lingers in the ground; the rays of the Sun of Righteousness have penetrated too deep to have their influence extinguished by a passing tempest; the storm has raged, and the gloom has lowered, but, meanwhile, the rain of heaven has moistened the earth; and, when the jarring elements have expanded their fury, thousands of plants open their bosoms to the genial influence, and find the air more pure and balmy, and the sky more bright and serene.

Yes! He, who searches the heart, knows his own people. The Holy Spirit is never absent, though his operations are not always visible to our feeble and jaundiced eyes. 'The wind bloweth where it listeth, and thou hearest the sound thereof, but thou canst not tell whence it cometh, and whither it goeth: so is every one that is born of the Spirit.' There is a sovereignty in divine grace, which mocks human research; yet never does the secret aspiration of the pious soul escape the ear of the Saviour, or fail to bring down an answer of peace. I know not if there be any thing more encouraging to the affectionate but doubting heart, in all the gracious declarations of our Lord, than that simple but soul-moving answer, by which he satisfied the anxiety of the guileless Nathaniel, 'Before Philip called thee, when thou wast under

the fig-tree, I saw thee.' To know that we are always the objects of Divine care; that there is an unseen eye ever watching over us for good, a secret ear listening to our deep-breathed prayers, a silent hand bringing good out of seeming evil, and causing even sorrow and suffering, sickness, and death itself, to promote our eternal interests,—this is peace! this is triumph!—a peace which passeth understanding—a triumph which is a foretaste of celestial joy.

NINTH WEEK—MONDAY.

NATURE OF SOILS.

I HAVE already cursorily adverted to the nature of the soil, and its general diffusion over the surface of the earth. I have also noticed the natural distribution of plants, and some of the remarkable properties with which they are endowed, so as to preserve a salutary balance between those which are more and those which are less useful, in reference to animal life. Were this arrangement perfect, there would remain nothing for man to do as a cultivator of the soil; but, although the general tendency is clearly towards perfection, yet in this, as well as in other particulars, there is obvious and intentional imperfection mingled with it. It is, without doubt, part of the plan of Creative Intelligence, that the arrangement should be so left as to admit of the beneficial interference of man, and to enable him to adapt it to his own advantage and convenience. This is true both with regard to the nature of the soil, and the properties of plants; and it will now be my pleasing task to point out some of the qualities and adaptations by which the former invites and rewards cultivation, and the latter, under the care and skill of rational beings, are rendered more subservient to use or enjoyment.

1. With regard to *soil*. The surface of the earth is composed of ingredients which are more or less prolific, according to their nature, and the proportions in which they are inter-

mixed. There is, first of all, simple earth, a substance which, when analysed, is found to be nothing more than abraded and disintegrated rock. It is not of itself prolific, or, at least, is so, only in a very slight degree, and indeed is considered by most physiologists as of no other use to plants than that of supporting them, or furnishing a medium by which they may fix themselves to the globe. Some earthy ingredients, indeed, are found in all plants, but they undergo no chemical change, and cannot properly be said to be the food of vegetables. The true nourishment of plants is water and decomposing organic matter, and these must be mixed in certain proportions with pure earth, so as to constitute soil. This is one principle on which the power of man, in rendering the soil fertile, is found to rest. He may by various processes—by mixing, for instance, with the land some vegetable or animal matter in a state of decay, where this constituent is deficient, or by adding earthy materials where this happens to be redundant; by loosening it with agricultural instruments, and thus subjecting it to the influence of water, when its indurated state prevents that necessary element from penetrating; or by draining it, and thus withdrawing a superabundant supply of moisture:—by any one of these means he may ameliorate the soil, and render it fertile, when it would otherwise be barren, or increase its prolific qualities when they do not yield a sufficient return.

Again, the mere mixture of ingredients already existing in a soil, and exposure to the atmosphere, are found to produce a beneficial result, by promoting fermentation, and by subjecting them to the influences of the sun and the air. Here, again, man has the means of increasing the prolific quality of the soil, and of rendering it more fit for his use

These, and various other operations, are rendered importan by the actual state of soils over the surface of the earth. In a great majority of instances, the land is not in such a highly prolific state as to be incapable of improvement by judicious management; and even where it is composed of ingredients mingled in the greatest perfection, and in the most beneficia

proportions, it becomes deteriorated by use, so as to require constant attention. Such an arrangement is best fitted for the present condition of the human race. There is here something calculated to stimulate industry and ingenuity, by holding out the prospect of advantage.

Nor must it be forgotten, that the various materials necessary for the amelioration of the soil, are very generally within reach; and that the operations by which these materials may be rendered available, are in themselves sufficiently simple, and require instruments by no means complicated. Were it otherwise, the condition would be unsuitable to the circumstances of man, except when considerably advanced in civilization; and obstacles would be interposed, at the very outset, which might prove fatal to his improvement, not only in this but in other respects. Let us suppose, for a moment, what would be the consequence to agricultural progress, in its earlier stages, if the only method of improving the soil, were by excavating manure, for example, from the hard rock, as is the case in the application of lime, and causing it to undergo decomposition by fire. Such an operation would obviously be too recondite to be discovered by man in an uncivilized state, and too difficult and complicated to be generally reduced to practice. But the ordinary means by which the soil is improved, are readily at hand, and are too obvious not to be discovered in the natural course of things, without scientific knowledge, or more skill than is acquired by man in a very early stage of society. As soon as he has begun to turn up the earth, he discovers that the vegetables with which its surface was covered, fertilize the soil as they decay; the dung accidentally dropped, he observes to give peculiar vigour to the vegetation in those places where it has been covered in; the land he finds to be better adapted to the growth of plants, when cleaned of weeds, and pulverized; too much and too little moisture he discovers to be equally injurious. It is thus that, in a short time, and with the simple exercise of a little observation, the great and leading principles of agriculture are unfolded, and the soil yields its powers to man, without the aid of science.

The importance of all this facility will appear more clearly, when we consider how much of human improvement and happiness depends on the resources of agriculture. It is from this employment, indeed, that the advancement of society in the arts and sciences may be considered as mainly taking its origin. While men gain their subsistence by hunting or fishing, they are always in a savage state, having seldom any fixed habitations, but roaming through the forests, or frequenting the sea-coasts or the banks of rivers, wherever their means of subsistence in the various seasons of the year may be found most abundant. The shepherd state, indeed, implies considerable advancement beyond that which we have mentioned. It supposes the recognition of personal property, and sometimes also, but by no means generally, a settlement in a particular locality, and the possession of a few domestic comforts. But it is not till man has advanced a step further, and has begun to cultivate the soil, that he makes any very important progress in civilization, or becomes bound permanently with his fellows in the bands of a well-organized community. It may, therefore, be regarded as a proof of wise and beneficent arrangement, not only that the soil requires, and rewards cultivation, but also that the means by which that cultivation may be effected are so easy of access, and so patent to general observation.

NINTH WEEK—TUESDAY.

FORMATION OF SOILS.

I HAVE observed, that the simple earths are produced by the decomposition of rocks, and it may be proper to show how this process takes place. This I shall do in the words of Sir Humphrey Davy, who has expressed himself with much philosophical precision, and, notwithstanding the scientific terms he employs, with sufficient plainness to make his general meaning understood by an unscientific reader. 'The manner in which rocks are converted into soils, may be easily

conceived, by referring to the instance of soft granite. This substance consists of three ingredients, quartz, feldspar, and mica. The quartz is almost pure silicious earth, in a crystalline form. The feldspar and mica are very compounded substances, but contain silica, alumina, and oxide of iron. In the feldspar there is usually lime and potassa; in the mica, lime and magnesia. When a granitic rock of this kind has been long exposed to the influence of air and water, the lime and the potassa contained in its constituent parts, are acted upon by water or carbonic acid, and the oxide of iron, which is almost always in its least oxidized state, tends to combine with more oxygen. The consequence is, that the feldspar decomposes, and likewise the mica, but the first the most rapidly. The feldspar, which is, as it were, the cement of the stone, forms a fine clay; the mica, partially decomposed, mixes with it as sand; and the undecomposed quartz appears as gravel, or sand of different degrees of fineness. As soon as the smallest layer of earth is formed on the surface of a rock, the seeds of lichens, mosses, and other imperfect vegetables, which are constantly floating in the atmosphere, and which have made it their resting-place, begin to vegetate. Their death, decomposition, and decay, afford a certain quantity of organizable matter, which mixes with the earthy materials of the rock; in this improved soil, more perfect plants are capable of subsisting. These, in their turn, absorb nourishment from water and the atmosphere, and, after perishing, afford new materials to those already provided. The decomposition of the rock still continues; and at length, by slow and gradual processes, a soil is formed, in which even forest trees can fix their roots, and which is fitted to reward the labours of the cultivator.'*

To this account I may add that of Dr. Sigmond, who thus clearly and elegantly describes the process by which a vegetable soil is gradually formed:—'First, upon the burning sand, or naked rock, the simplest structure of vegetable life, the lichen, almost invisible to the eye, fixes itself, blown pos-

* Elements of Agricultural Chemistry, p. 188.

sibly by the breeze. Its generation is scarcely understood,—it boasts no flowers which require time for their development, or food for their secretion. They struggle through their ephemeral existence, either upon the confines of eternal snow, or upon the scorching regions of the torrid zone; they fulfil the general law of nature—they die; but in their death they are the harbingers of life: They decompose; the particles of which they are formed unite with the oxygen of the air; an acid is the result, which eats its way into the crevices of the rocks, or insinuates itself amid the sand, when its other particles form new combinations, and, burying themselves, become a first layer of vegetable mould; cracks and crevices thus are formed, in which moisture is deposited; these become enlarged, either by the expansion produced by heat, or by frost; the granite mass is burst asunder, or slow disintegration occurs. In the thin stratum of mould a tribe, a little higher in the scale of vegetable life, is developed, probably some elegantly-formed moss, which bears a miniature resemblance to trees and shrubs; these, too, run through their destined course; they die, and leave behind their remains, for the birth-place of some more perfect plants, such as the grasses, the saxifrages, the wormwoods, and plants with small leaves and low slender stems. The vegetable mould now deepens; generation succeeds to generation; plants of a more complex structure, and of a higher stature, such as shrubs and bushes, begin to rise upon the rock, or the sand, now no longer an inhospitable mass; at last the loftiest monarchs of the forest are developed, and spread over an immense surface, for perchance a single seed, wafted by wind, borne by some bird, washed by some flood, or swallowed by some animal, and thus prepared for germination, is the means by which the new generation bursts into birth, and changes the face of nature. There is an uninterrupted circle of events on which the preservation and the gradual improvement of all the productions of nature hangs, and there is an endless source of inquiry for man.'*

The processes here described are such as are at this mo-

* The Lancet.

ment proceeding on the surface of the earth. But they do not of themselves account for the phenomena which the surface of the earth at present displays. If the reader has at all attended to what has been said in the 'Winter' volume, respecting geological changes and revolutions, he will understand in what manner these operations may have been accelerated, and the various soils, thus formed, may have been removed and mixed. The hand of the great Creator is as conspicuous in the one class of operations as in the other; and while we trace these operations, we should never lose sight of Him, who not only at first endowed matter with such tendencies, but who afterwards presided over and controlled all its convulsions, so as to fulfil his high behests, and finally, to produce a world so admirably fitted for the habitation of a race of rational beings, such as man.

Peaty soils are produced by very different causes from those already mentioned. They arise from the accumulation of neglected vegetable matter in moist situations. Where successive generations of vegetables have grown upon a soil, Sir H. Davy observes, unless part of their produce has been carried off by man, or consumed by animals, the vegetable matter increases in such a proportion that the soil approaches to a peat in its nature; and, if it happen to be in a situation where it can receive water from a higher district, it becomes spongy and permeated by that fluid, and is generally rendered incapable of supporting the nobler class of vegetables. Another mode in which peat has been formed, is by the gradual accumulation and decomposition of aquatic plants in shallow lakes and stagnant pools. This kind of peat is of a more loose and spongy quality, and the fermentation which takes place seems to be of a different kind, more gaseous matter being evolved. What has greatly contributed to the growth of peat is the destruction of ancient forests, either by the operation of some natural cause, or by the hand of man. In Britain, and various parts of the European continent, the conquests of the Romans seem greatly to have contributed to this. That adventurous and warlike people, found it neces-

sary, for the evolutions of their armies, to destroy the extensive woods which formed the natural fastnesses of the inhabitants; and, having accomplished this object by fire or by other means, they suffered the unconsumed trees to lie where they fell; and these, where the ground was level, damming up the little brooks and rills, and causing the moisture to accumulate, gave rise to a coarse vegetation, which, in process of time, formed into extensive morasses. The existence of great quantities of wood, in various stages of decomposition, having sometimes very obviously undergone the action of fire, sometimes of the hatchet, in almost all the mosses of this country, may readily be accounted for on this supposition.

It is instructive to observe, in the management of soils, a principle not yet adverted to, but brought into view by this account of the origin of peat-bogs and mosses. Land, as appears by this example, is capable of deterioration by neglect or abuse, as well as of improvement by cultivation. The peaty soil of Great Britain and Ireland, and, indeed, it has been alleged, of the habitable globe, constitutes nearly one-fourth of the whole surface. This ungenial soil is constantly on the increase, wherever it is not arrested in its progress by human industry. Here, then, we have a stimulus to exertion, the converse of that previously mentioned. The former holds out a reward to industry, the latter acts as a punishment upon negligence and sloth. This is entirely in conformity with the operations of Providence in other respects, and indeed, in various modes, enters in to all the operations of agriculture. While judicious management never fails to repay the active and intelligent cultivat or by an improved soil and a liberal return, the slothful and foolish find, to their cost, that the ground cannot be neglected or abused with impunity. The field of the sluggard is quickly filled with noxious weeds, which encumber the soil and destroy the useful plants intended to be produced. Excessive or unskilful cropping reduces the soil to barrenness. In either case, the earth resents, as it were, the treatment she receives, and refuses to give forth her fertility.—Such is the wise decree of the Most High.

NINTH WEEK—WEDNESDAY.

MANAGEMENT OF SOILS.

From what has been already said, it appears, that the constituent elements of soil, as regards their general chemical properties, are very simple. There are, however, various modifications of these elements, which render the subject somewhat more complicated than it might at first sight appear. Not only are the ingredients mingled in very different proportions, but, by their chemical combinations, their appearance and properties are altered, so as to constitute soils of very different quality. All these circumstances give rise to the necessity of varied management, and a variety of agricultural implements, which increase in number and perfection in proportion as the science is better understood. In treating of this subject, with reference to the manner in which these arrangements are adapted, by Creative Wisdon, to the condition and powers of human beings, it is evident, that it will be necessary to confine ourselves to a consideration of the broad and general features which it exhibits.

British soils may, in this view, be arranged into four different classes, according to the ingredient most predominant in each, whether clay, sand, gravel, or moss. Each of these requires a different mode of cultivation. A clay soil, in whatever way it may be distinguished—by its colour of black, white, yellow, or red—differs from all other soils, by being tough, wet, and cold. It holds water like a cup, and, consequently, when once wetted, does not soon dry; and, on the other hand, when once dry, is not soon saturated with moisture. In a summer without rain, the surface is covered with chinks or cracks, and is, in this way, prepared by the hand of Nature for receiving the water when it falls. In this latter state, when ploughed, it is found to be hard and cloddy, and not easily pulverized by labour; and if, on the other hand, it be ploughed when full of moisture, it sticks to the plough like mortar.

This description shows the difficulties with which the agriculturist has to contend, when such soil is subjected to his management. He must employ his art in rendering it less adhesive, both that it may become more pervious to moisture, and better fitted to admit the free insertion of the rooty fibres of the plants sown upon it. This he may effect in various ways. Top-dressings of other kinds of soil, a liberal use of lime, frequent ploughing, considerable quantities of manure, are among the means usually employed in such a case, and not employed in vain. By such means, the stiffest and most unproductive clay can be converted into a rich loam, which bountifully rewards the skill and labour bestowed on it.

Sandy soils are of a very different nature, and are subject to defects of an opposite description. When there is little foreign admixture in this kind of soil, it is light and barren, and requires a considerable addition of other earths to render it fruitful. It is, under all circumstances, loose and crumbling, and is not susceptible of equal improvement with the land already described. In dry weather, the moisture, having rapidly escaped, both by evaporation and filtration, leaves the soil without a sufficient quantity of nutritive juices to bring the plants to perfection, and thus the crops must be always comparatively precarious. Much, however, may be done to counteract this defect; a remarkable instance of which is presented to us in the agriculture of Norfolk. Nearly one-half of the lands of that country were little better than a barren waste. But a judicious system of management was adopted:—By a liberal use of clay and marl, and common manure, during a considerable period, a new soil may be almost said to have been created; and, when a crop of clover precedes one of wheat, this plant, by acting mechanically, so as to bind the surface, and perhaps also by some unknown chemical operation during its decay, produces so favourable a state of the soil, that a very large quantity of grain is frequently the result.

A gravelly soil is nearly allied to one of sand, and is subject to similar defects; the main difference, indeed, is, that

the former is mixed with small stones, generally soft, but sometimes also of a flinty or chalky nature. This soil requires to be deepened by the plough, and by frequent dressings of marl, earth, or clay, as well as enriched by liberal applications of manure. Under such management, the return, in ordinary years, will be liberal; but drought, as well as frequent and heavy falls of rain, is injurious; and, though the cultivation is easy and unexpensive, the return is not secure.

The last kind of soil which was noticed, is that of peat-moss. This, in its natural state, does not produce plants valuable for the uses of man, but is capable of much melioration. 'The fundamental improvement of all peat soils,' says Mr. Marshall, 'is drainage,* which alone will, in a few years, change a boggy to a grassy surface. After being drained, the surface may be covered with earthy materials; pared and burned; fallowed, dug, trenched, or rolled. The celebrated Duke of Bridgewater covered a part of Chat-moss with the refuse of coal-pits,—a mixture of earth and stones, of different qualities and sizes,—which was brought in barges out of the interior of a mountain; and this, by compressing the surface, enabled it to bear pasturing stock. Its fertility was promoted by the vegetable mould of the morass, which presently rose, and mixed with the heavier materials spread upon it.'†

This imperfect sketch of various kinds of soils, and the means necessary for rendering them fertile, may be enough to show the kind of ingenuity and industry destined for man to apply, in rendering them more productive. As they actually exist, they render the surface of the globe sufficiently prolific for the purposes of the lower animals, and of man himself, till the population has advanced to a certain point; but the powers of increase press so rapidly on the means of subsistence, that additional food is soon demanded, and then the

* Draining by means of tiles, or of broken stones, has lately been adopted to a great extent, and with much success, on all soils too much saturated with water.

† Marshall on Landed Property, p. 46.

labours of man, as an agriculturist, commence. He finds it easy, in this way, first to alter the produce of the soil, so as to augment the quantity of plants fit for his own subsistence, and that of those herds and flocks, which he has tamed, and rears for his use; and he gradually learns, also, to meliorate the land, and even the climate, so that, as the population becomes more numerous, new means of subsistence may proportionally be found for it. So powerful, indeed, is the law of propagation, that a constant struggle is maintained between the powers of man, in increasing his resources, and the growing amount of the population,—the latter always urging forward, and being ready to overpower the former, till, at last, the maximum of cultivation arrives, while the power of reproduction remains the same, or rather accumulates with the accumulating numbers of human beings; and thus a crisis takes place, the nature and consequences of which have already been slightly alluded to, and cannot at present again be entered upon. So far as we have proceeded, I trust the position I set out with has been satisfactorily illustrated,—that the condition in which the surface of the globe has actually been placed, exhibits the adaptations of a Designing and Intelligent Mind. Other proofs in abundance yet remain to be produced.

NINTH WEEK—THURSDAY.

MANAGEMENT OF SOILS.—DRAINING—IRRIGATION.

Before leaving the subject of soils, it seems desirable to advert more particularly to some of those processes, yesterday slightly hinted at, by which man, in the use of that reason which God has given him, prepares them, or renders them more suitable, for his use. It would be foreign to my purpose to write a treatise on agriculture, and I shall confine myself to one or two of the more prominent examples of these operations.

The estate of Spottiswoode, in Berwickshire, affords an interesting instance of successful drainage of mixed soil and strata. It was begun in 1815, under the direction of Mr. Stephens, an eminent draining engineer, and eighteen miles and a half of drains, some parts of which were thirteen feet deep, but the medium depth of which was from five to seven feet, had, in 1820, rendered between 500 and 600 acres of land highly valuable, which before was comparatively worthless.

The grounds to be drained consisted of a soil of various depth, under which commonly lay a stratum of clay, of two or three feet deep; then a thin bed of sandy or gravelly substance, of a foot deep or more, containing water; after that, another bed of clay, of two or more feet deep; and lastly, a bed of sand, gravel, or slatey rock, containing the larger quantity of water. Upon reaching the lower of these porous strata, the water disappeared in the upper one; and hence, generally, the expediency of not stopping at the first, but of working down till the main stratum was reached. Several instances occurred, where the strata lay too deep to be reached by a drain; in which cases it was deemed necessary to sink wells or pits, at certain distances, along the line of the drain, from ten to fifteen feet deep, or more, to reach the open strata, so that the water, rising through the wells to the bottom of the drains, might be conveyed away without reaching the surface. It was never thought sufficient to have reached the first seam containing water, unless it were at the depth of four feet or more, and evidently appeared to be that containing the main body of water, which occasioned the wetness of the surface.

The first operation in the process of draining, was to ascertain the depth and the nature of the strata in which the water was contained, and the overflowing of which, where no other existed, produced, as was before remarked, either springs or bursts of water, or a general oozing. 'Along the line of these springs, or in the upper part of the wet ground, pits were sunk in various places. The place of each being marked out, a man was sent to dig each pit, breaking the ground

nearly in the direction of the intended drain, six feet long and three feet wide, which is sufficient space to allow a man, or sometimes two, to work freely. The earth was then thrown to the lowest side, and well off from the pit, to prevent the sides from breaking in; these pits were made to the depth of five or six feet, or to a greater depth if necessary, according to the nature of the ground, or until the bed of sand, gravel, or rock, which contained the water, was reached.'* Having, by this operation, ascertained the direction and depth of the strata, the drains were cut, filled up with stones, and covered in; and the operation having completely succeeded in producing the desired effect, the ordinary modes of cultivation were resorted to.

The above is an example of reclaiming lands too much saturated with moisture; but plants cannot live without water, any more than they can prosper where it is superabundant. Hence the practice of *irrigation*, which mode of improving the soil I shall next consider. There are two different modes, which have been successfully employed, the one being the application of water to the surface, the other, the conveyance of it by subterraneous drains. In both practices, the object is to imitate nature, in producing motion, and in supplying the water under a clouded sky, or in the mornings and evenings, when the rays of the sun are either withdrawn, or have ceased to be intense; and the necessity of attending to this, which has been demonstrated by experience, affords a new and instructive proof of the adaptation of vegetation to the ordinary physical phenomena of clouds accompanying the fall of moisture from the atmosphere. The importance, indeed, of imitating nature, occurs to the agriculturist at every step, and constantly reminds him of such adaptations. In the present process, for example, another instance of this occurs, in the practical advantage of attending, in such a climate as ours, frequently to withdraw the water, and only apply it at intervals, thus imitating the alternate sunshine and showers of temperate regions.

* Transactions of the Highland Society, vol. vii. p. 222.

In surface irrigation, the water is conveyed in a system of open channels. This mode of watering has existed from time immemorial. Moses speaks of the children of Israel, when in Egypt, sowing their seed, and watering it with their foot; that is, as Calmet explains it, raising the water from the Nile by means of a machine worked by the foot, from which it was conducted in such channels as are used in the present day. This practice, which is still common in Egypt, was doubtless suggested by the peculiar climate and circumstances of the Delta of that country, where rains very seldom fall, the want of which is supplied by the periodical overflowings of the Nile. There are many places even now, in that region, and there must have been many more in those early times, when alluvial formation was not so deep or so extensive as it has become in the revolution of ages, which the waters of the Nile did not reach in its inundations. These situations would, of course, prove barren from want of moisture. The thought would naturally occur, that an artificial application of water to these places, would be advantageous, and the use of a wheel for raising the water from the river, seems to have very early suggested itself to some ingenious projector, as the means of accomplishing this object. The invention was too important not to be eagerly adopted by an industrious nation, whose population was rapidly increasing, and was confined to certain limits by the nature of the country, enclosed, on its different boundaries, by seas, barren mountains, and still more barren sands. Hence, perhaps, the origin of surface irrigation,—a practice very generally pursued in various parts of the world. The wheel used by the Egyptians, in those early ages, was probably a more simple machine than the *Noria*, also an Oriental invention of very remote antiquity, but of great power, which was introduced into Spain by the Moors, and is still extensively used in the Southern and Eastern provinces of that kingdom. This ingenious piece of mechanism consists of a series of earthen jars, attached to an endless rope. These pass over a vertical drum, put into motion by a trundle and horizontal cog-wheel, which last

is usually turned by a single bullock, or more, when the size of the machinery requires it.

Subterraneous irrigation is effected, either by a system of drains or covered gutters, in the subsoil, or where the under stratum is gravelly, and rests on a retentive bed, by merely damming up surrounding trenches, if the ground be flat, or leading a stream along the highest elevation, if it be sloping. This practice is used in Lombardy, on the alluvial lands near the embouchures of the Po. In Lincolnshire, the same mode is practised, by shutting the flood-gates at the mouths of the great drains, in the dry seasons, and thus damming up the water through the ramifications of the drainage from the sea to their source. A similar plan, on a smaller scale, has, in some instances, been practised in Scotland, where deep mosses had been drained and cultivated, and where, in summer, vegetation failed from deficiency of moisture.

NINTH WEEK—FRIDAY.

BLAIR-DRUMMOND MOSS.

I SHALL, in this paper, detail another mode of successful cultivation, which has been adopted on a large scale, in one locality, and the principle of which, though not of general application, may doubtless be employed in other situations. I allude to the method of reclaiming a fertile soil, by the removal of a barren surface, which has been practised in the parish of Kincardine, in the neighbourhood of Stirling.

The Moss of Kincardine extended to upwards of 2000 acres, 1500 of which belonged to the estate of Blair-Drummond. It lay upon a clayey bed, which is a continuation of the rich alluvial soils that form the flat vales, called *carses*, of Stirling and Falkirk. The plain in question had, at some early period, been covered with trees, which had been felled, probably by the Romans; and this, by a natural process, already alluded to, ended in producing the moss. This moss consists

of three different strata: the first, or lowest, black and heavy, appears to have been formed of bent grass and fallen trees; the second is composed principally of *Sphagnum palustre*, and is brown, and of an elastic texture. The third is about a foot thick, and consists of heath, and a little bent grass. In general, these three strata are about the depth of seven feet. Lord Kames obtained possession of this moss in 1766; and, soon after, conceived the idea of floating off the strata into the Frith of Forth, and thus exposing the alluvial soil for cultivation. After various interesting experiments, which I cannot stop to detail, he adopted the following plan:—

His first object was to procure a sufficient quantity of water to create a stream, of force enough to carry off the moss in its current. This was done by the erection of a wheel, somewhat resembling the Persian wheel, or Noria, already described, but of great dimensions, and on an improved principle. It was twenty-eight feet in breadth, and was driven by water, with float-boards, in the same way as an ordinary mill-wheel. At the extremities of the radii, or arms of the wheel, immediately within the float-boards, was fixed a double row of buckets, opening upwards when at the bottom of the circumference, and downwards when at the top. These received two streams of water, which were poured into them when they were below, and which they discharged when they ascended and were inverted by the revolution of the wheel, into a trough or cistern, so placed as to receive it above. By this means, a level was gained of seventeen feet, which was sufficient to make the water run to the surface of the moss. The water was conveyed from the cistern of the wheel, to the moss, for 354 yards below ground, in wooden pipes, hooked with iron, eighteen inches in diameter within; and afterwards rose from the pipes into an open aqueduct, about 1400 yards in length, and elevated from eight to ten feet above the level of the adjacent grounds.

Having thus obtained the necessary power, the work of removal was begun; and, for accomplishing this, the first step was to make, in the clay, alongside of the moss, a drain to

convey the water, for which operation the *carse* clay below the moss was peculiarly favourable, being perfectly free from stones, and all other extraneous substances; and, at the same time, when moist, being slippery as soap; so that, not only was it easily dug, but its lubricity greatly facilitated the progress of the water, when loaded with moss. The dimensions proper for the drain were found to be, two feet for the breadth, and the same for the depth. If smaller, it could not conveniently receive the spadefuls of moss; if larger, the water would have escaped, leaving the moss behind. The drain had an inclination of one foot in a hundred yards. The more regularly this inclination was observed throughout, the less was the moss liable to obstructions in its progress to the river. The drain being formed, the workman marked off, to a convenient extent, alongside of it, a section of moss, ten feet broad, the greatest distance from which he could heave his spadeful into the drain. This operation he repeated, till the entire moss was removed, almost down to the clay. He then dug a new drain, at the foot of the moss-bank, turned the water into it, and proceeded, as before, leaving the moss to pursue its course into the river Forth, upon the fortunate situation of which, happily forming, for several miles, the southern boundary of the estate, without the interposition of any other property, depended, in some measure, the very existence of the whole operations.

When the moss was nearly removed, the clay was found to be encumbered with roots of different sorts of trees, often very large, remaining in it as they grew. Their trunks also were frequently found lying beside them. All these the tenants removed, often with great labour. In the course of their operations they purposely left a few inches of moss upon the clay. This, in spring, when the season was favourable, they reduced to ashes, which, in a great measure, insured the first crop. The ground thus cleared, was turned over, where the dryness admitted, with the plough; and, when too soft for that operation, was dug with the spade. A month's exposure to the sun, wind, and frost, reduced the clay to such a state as

fitted it for the seed in March or April. A crop of oats was the first produce, which seldom failed of being plentiful, yielding from eight to ten bolls after one.*

The ingenious and successful operation above described, is only applicable to very peculiar localities, where various circumstances concur, not usually combined. The fine tenacious alluvial soil beneath, and the immediate neighbourhood of a river, very happily united to afford facilities to this singular undertaking; but, in any light in which it can be viewed, it furnishes a striking instance of what the skill of man can effect, in increasing the natural resources of the soil; and it should serve to quicken ingenuity, and excite enterprise, in an object of so much importance. There is, doubtless, much waste land in Europe, and even within the bounds of the British Islands, which, under a spirited system of improvement, might be made to yield, if not an equal, at least an adequate return. Peat-bogs and swamps might be drained; downs might be arrested in their progress of devastation, and even sometimes removed; commons might be divided; forest-lands might be cleared; rivers might be embanked; and, in many instances, large tracts of valuable soil might be reclaimed from the sea; while water might be procured from the bowels of the earth, by sinking Artesian wells, or streams might be profitably turned from their course, to cheer and fertilize districts rendered barren from a defect of moisture. These are some of the expedients which Providence has placed within the power of man, to enable him to add to the means of human subsistence, while they call forth and usefully exercise his faculties.

It is true, that, as a mode of counteracting the inconveniences arising from the law of propagation, such operations can only prove a partial and temporary relief, even when conducted on the largest scale; for such is the elasticity of this law,

* Farmer's Magazine, vol. xviii. Mr. Home Drummond, the present proprietor, completed, in the summer of 1836, the whole of the operations projected by his ingenious father; but other proprietors in the neighbourhood have adopted, and are carrying on, the same mode of improvement.

that the population could not fail, in a few years, to be again pressing, with the same force as ever, against the supply of food; but, in the meantime, the numbers of the human race would be permanently augmented; many happy and industrious families would be reared, within the boson of the country, which would otherwise not exist at all, or would be carried away, by emigration, to increase the wealth and strength of foreign lands; and the general salubrity of the climate would be increased, as well as the effective resources of the state.

NINTH WEEK—SATURDAY.

PRODUCTS OF THE SOIL.—DISSEMINATION OF PLANTS.

From the preparation of soils we naturally pass to the consideration of the various productions which are the objects of culture. But before entering on this subject, a few introductory remarks may be desirable on the creation and natural diffusion of plants in general.*

The sacred record does not inform us whether the whole of the numerous races of the vegetable kingdom appeared simultaneously in every part of the globe where the soil and climate were suitable for their growth, or emerged from particular localities fitted for the production of all the species. That such localities exist, we have good reason to believe. The Himmalayeh Mountains, for example, afford specimens of almost every climate. Situated within the tropics, and yet stretching their lofty summits till they penetrate the region of perpetual snow, they seem to contain within themselves a microcosm, in which all tempe atures and all terrestrial zones are represented, and where the productions of every parallel on the face of the globe may find adequate and congenial

* For much of the substance of this paper, I am indebted to Mr. Sharon Turner's 'Sacred History of the World' (Letter vii.), though I do not adopt his theory.

nourishment. To such a situation, it is possible, that the Creative energy may have been confined; and, on this supposition, it is no very difficult matter to conceive how the various plants, and even animals, may have been gradually diffused over the terrestrial surface. At all events, granting that the various species of organized existences were produced by an universal Creative energy, and that thus the earth became peopled with animals, and clothed with vegetation at once, a new diffusion must have become necessary after the ancient surface of the globe had been overwhelmed with the flood. It is true, as I formerly noticed, that the waters of the universal deluge would diffuse the seeds of plants very generally over every region; and, where circumstances were favourable, those which happened so be deposited on or near the surface, would quickly vegetate. But there is reason to believe that another process has likewise been extensively employed.

If we consult our historical and geographical communications on this subject, we find that the vegetation of many countries which have been examined, and of all newly formed islands, has been, and still continues to be, progressive; and we may trace it ourselves on many places near our domestic residence. We have already noticed the first processes in the formation of soil, which are still in progress. We see the lichen class arise as their minute seeds descend, and decay and reappear from new germinal matter, till they have formed enough of vegetable substance for the sporules of the mosses, which, at their seasons of fructification, float extensively in the atmosphere, to fix on and to grow from. These mosses, also, vegetate and decay; and on their decayed remains, a new vegetation of the same sort springs up, in like manner to die, and become a thicker mould for the germination of the passing seeds of other plants. Every year thus produces a new bed of vegetable matter, which is frequented by the seeds of new plants, and, in time, of trees, as various causes bring them to the spot. Thus, in the course of a few years, every new coral island that is made by its petty architects,

and every volcanic one that rises in the sea, become covered with plants and trees.

It has been observed of the rocky places, where only the lower and smaller classes of vegetable nature can subsist, that the seminal particles do not spring up from some, but yet will evolve from others. Each, as it floats along the ever-moving breeze, selects, as it were, its own proper bed of nutrition, and there unfolds its efflorescence, and produces its successor. Aqueous plants would in like manner arise, as their seeds were wafted to watery places. And in this way vegetation has assuredly, in many instances, spread from the district where it was flourishing, to those which it had not before reached. The processes I have mentioned would soon clothe the earth with an abundant vegetation, and would everywhere precede the dispersion of the lower animals or man, providing for them the means of subsistence, to whatever region they should happen to wander. That one of the means by which vegetation has been spread over the earth, is the gradual dispersion which I have described, is certain from the fact, which history and observation unite in establishing, that the largest portion of the herbs and trees, which any nation now possesses, has been thus successfully introduced. We can trace the chronology, and date at no very distant period the origin, of no small part of our own insular vegetation; as we can also of several of our fishes, birds, and quadrupeds. It is natural to infer from what we know to have thus taken place in the latter ages of the world, that similar processes operated in its primordial times.

It must further be observed, that the vegetable soil on the surface of the earth, is, by the very process of alternate growth and decay, always tending to greater depth and fertility, at least in the more favoured situations. Hence it follows, that localities are constantly changing their capacity for sustaining particular kinds of vegetables, and this consideration alone renders it probable that the vegetation of every country has progressively advanced in the multiplicity of its species, according as the mould became fitted to receive and nurture the more important plants.

Whether the primeval creation of vegetation was its instantaneous and universal diffusion over all the globe, or the emergence of it only on so much of the surface as would allow every species to appear, with a subsequent dissemination of it to every other part, by gradual succession, still we may be sure, that the same results would occur on either system. If the first formation were immediate and general, it would be but an instantaneous production of the same effects as the progressive diffusion would occasion. No spot could or would have the whole body of all plants upon it, but every place would have its own suitable vegetation, whether immediate or gradual. The marsh, and the sea-shore, and the bed of the ocean, would protrude those of the watery species; the rock would retain the lichen, the barren soils would receive the heath or the thistle; the valley would cherish those that suit the low ground; and the mountain possess such as flourish best on elevated regions, while trees would arise in the localities fittest for their production. Each district would have at first what would grow best upon it, and all would begin the disseminating process, as soon as their reproductive systems came into action. Diffusion is the law, and must have been in constant operation, from the first period of their being. Those parts which had only the minor species of plants, would have those of the higher classes, as soon as sufficient seasons and their decayed foliage had prepared a soil adapted to the germination of their arriving seeds. Whatever was brought or wafted, would vegetate only where it found a soil fitted for its nature; and thus, within a century or two after its creation, the surface of the earth would be nearly in the same state, as to its herbage and forests, whether they originated from a particular locality, or from a universal formation.

TENTH WEEK—SUNDAY.

THE SOWER.

The most important operation in the fields at this season, is unquestionably the sowing of the seed. On it the support of man and many of the inferior animals, chiefly depends. But, independently of the importance of his labours, the sower, as he stalks along the freshly ploughed field, is one of the most pleasing objects that spring presents to our observation. The sight of him heightens our enjoyment of the passing season, and in an instant transports us to the yellow treasures of harvest. There are associated with him many pleasant feelings, many poetic images; and if ever the oft-imagined picture of a peaceful age strikes us with all the force of reality, it is when we see him scattering the seed from his well-filled sheet, and surrounded with the various lively adjuncts of rural labour.

But the sower may be made the subject of much profitable reflection, well suited to the employments of this holy day. His labours are, of all others, pregnant with instruction. Why does he toilfully traverse the rough furrows, and cast from him the valuable grain to mingle with the earth? Why does he, with much pains and industry, first prepare the soil, and even when the seed is sown, tend it with unwearied diligence? It is because he confidently expects a bounteous return for all his anxiety and labour. He thus practically shows an unwavering belief in a coming harvest. Now, what lies at the bottom of this belief, which is as strong as assurance itself, but his experience of the undeviating uniformity of the great laws by which the world is governed? And what are these laws but the operations of the Supreme Ruler of heaven and earth? The sower, then, even though his understanding be unenlightened, and his heart untouched with pious emotion, may be said to depend upon the continually exerted goodness of that God who animates and directs

all nature, and who pronounced the primeval promise,—'While the earth remaineth, seed-time and harvest, and cold and heat, and summer and winter, and day and night, shall not cease.' He knows that the seed he commits to the earth immediately corrupts; but that the miracle of the green blade springing up from the decayed husk, and containing the germs of the future grain, will not be performed, never once enters his mind. With the implicit belief of a child, he awaits the unfolding and ripening of the precious ear. And what ground has he for his trust, we again ask, but the goodness and faithfulness of God? Thus, the sower, in regard to temporal things.

Now, the same Almighty Being who has pledged his word for the continuance of seed-time and harvest, and has promised 'seed to the sower and bread to the eater,' has also promised to feed his people with the bread of life, and to make them 'reap if they faint not.' But while we admit his gracious promises, we continually exhibit a practical distrust in them all. We share the hope of the sower, and with him expect to be annually supplied with food; but our expectation of a constant supply of spiritual good things is neither so cherished nor so lively; as if God were indeed more solicitous to support our mortal bodies, than to feed with heavenly food the undying spirits within us. We are ever apt to be so grossly inconsistent, as firmly to rely upon the constancy of Nature, and yet have but a feeble faith in the written promises of Nature's God. We believe that, in a few short months, harvest will assuredly arrive; but we realize not, with the proper vividness and power, the glorious harvest to be reaped by the redeemed, both in 'the life that now is, and in that which is to come.' Yet our plain duty is, to trust God in all things,—in his word as well as in his works; to expect the spiritual sustenance and joy he has promised to his duteous children, with the same faith that we display in looking forward to the budding beauty of spring, or the teeming abundance of autumn.

When we see the sower scattering his seed, we are naturally

reminded of the apostle's beautiful illustration of the resurrection of the body. The grain deposited in the earth soon corrupts and is changed; but yet there upspring from it the elements of other seed; it dies, as far as regards its qualities as corn, but is immediately quickened for the production of grain like itself. So our mortal bodies are laid in the grave, and moulder away into their native earth; but the day is coming, when, from their silent resting-places, they shall rise to the re-enjoyment of life and breath. The tomb has also its wondrous and instantaneous spring: and as the grain that rises from the ground is not that which was sown, though essentially produced by it, so the risen bodies of the just are not the corruptible bodies that now descend to the earth, but glorified and spiritual frames, meet for heaven and unfading joy; —incorruptible and immortal, though sprung from decayed and earthly elements. Such is the glorious doctrine of the resurrection. O! can we fail to look forward to it with the most vivid expectation? Will not the same God, who, in the upholding of natural laws, causes, year by year, the grain to spring up from seeming dissolution, much more raise up at the appointed day, those fleshly tabernacles that now sink into the corruption of the grave? Surely, if he disappoints us not in the operations of his daily providence, and makes the constancy of Nature fulfil our certain hope, he will not deceive us in greater things, but will faithfully perform that most animating of all his promises, a resurrection to immortal glory.

There is also another impressive scriptural analogy connected with the sower. We are familiar, from our childhood, with that beautiful parable, in which the word of truth is represented by the seed which he commits to the earth. How apt and striking the emblem is, all must at once perceive. Many causes prevent or check the growth of the sown grain. It may be picked up by the fowls of heaven; the green blade may be choked by noxious weeds, or it may be withered by a scorching sun; and thus frequently more seed, in various ways, perishes, and produces no return, than swells the treasures of harvest. So it is with the preaching of the Gospel.

The temptations of our great spiritual adversary, the love of riches, the multiplied seductions of sense, persecution, and the various afflictions inseparable from a bold profession of the truth—all conspire to render ineffectual the doctrine of a crucified Redeemer. The gradual and imperceptible growth of the seed, that takes root, and brings forth fruit to maturity, is also beautifully illustrative of that growth in grace which distinguishes the true believer,—that silent extension of the kingdom of God which takes place in his heart.

We have not nearly exhausted the fertile subject of the sower's interesting labours. As he scatters the seed, he teaches many impressive lessons. Yet the operation he performs is only one of many that are constantly affording us instruction. Indeed, all the changes and objects of nature, all the splendid phenomena of the seasons, and all the labours of the husbandman, are fraught with the sublimest moral lessons; many of them are also eternally associated with the instructions and arguments of the Saviour and his inspired followers. J. D.

TENTH WEEK—MONDAY.

DISSEMINATION OF PLANTS.—THE COCOA-NUT TREE.

An instance of the power of the dissemination of vegetable substance, and, at the same time, of their adaptation to the use of man, is to be found in the history and properties of the cocoa-nut tree, which is so remarkable, and so strikingly illustrates the observations of last Saturday's paper, that it seems worthy of separate consideration.

The wonderful operations of the coral animalcule shall come under our notice afterwards; at present it is enough to observe, that by the continued labours of this tiny creature, through a succession of ages and generations, islands are

gradually formed in various parts of the vast South Seas, rising abruptly from the bed of the ocean, sometimes when it lies at the depth of several hundred fathoms. The matter which the coral insects secrete for their habitations, and which thus eventually forms, as it were, a new creation, is carbonate of lime, a substance which, on being elevated above the surface of the ocean, is slowly decomposed by the atmosphere, and combining with materials cast up by the waves, forms a soil fit for the support of some kinds of vegetable life. Among these, the cocoa-nut tree seems endowed by the Author of Nature with peculiar properties, for the express purpose of rendering these new made islands habitable. From an interesting account of this tree in the Wernerian Memoirs,* we learn, that it will grow on the sand of the sea-shore, where scarcely any thing else will vegetate; and Mr. Johnston informs us, that it has a very slight root, so that it is difficult to understand how it adheres to the earth, which it does, however, with sufficient firmness.† These properties admirably fit it for forming the first vegetable produce of the higher order, destined to clothe the new formed islands of the Pacific; and, accordingly, we find it every where readily springing up, as soon as a scanty soil is prepared to receive it. The manner of this process is thus described by Captain Flinders, after stating that the animalcules cease to work above low water mark:—'The coral sand and other broken remnants thrown up by the sea, adhere to the rock, and form a solid mass with it, as high as the common tides reach. That elevation surpassed, the future remnants, being rarely covered, lose their adhesive property; and, remaining in a loose state, form what is usually called a key upon the tops of the reef. The new bank is not long of being visited by sea birds; salt plants take root upon it, and a soil begins to be formed; a cocoa-nut, or the drupe of a pandorus, is thrown on shore; land birds visit it, and deposit the seeds of shrubs and trees; every high tide, and still more, every gale, adds something to

* Vol. v. p. 107.

† De Arboribus, p. 145.

the bank; the form of an island is gradually assumed; and, last of all, comes man, to take possession.'*

All this indicates an adaptation of the plants which grow in these tropical regions to this very peculiar formation. These are naturally formed to vegetate on a loose and shallow soil; and, of this class, all travellers have particularized the cocoa-nut, as at once the most remarkable and the most abundant. Forster says, that the recently formed islands of tropical seas, are commonly 'narrow low edges of coral rock, including, in the middle, a kind of lagoon, and having here and there little sandy spots, somewhat elevated above the level of high water, on which cocoa-nuts thrive.'† Captain Cook confirms this description. In mentioning one of these islands, or, what he calls a coral shoal, of about twenty leagues in circuit, he observes, 'A very small part of it was land, which consisted of little islets, ranged along the north side, and connected by sand-banks and breakers. These islets were clothed with wood, among which the cocoa-nut trees were only distinguishable.'

Now, let us consider the properties of this wonderful production. Johnston, speaking of the cocoa-nut tree in India, affirms, that there is no part of it which is not applied to some useful purpose. Not only the cabins of the poorer natives, but large houses, are constructed entirely with materials afforded by this tree; the trunk, when split, supplying rafters, &c., and the leaves, when plated, making roofs and walls, which are impervious to wind and rain. This statement of Johnston is confirmed by Seely, in his account of Ellora, who says, that, when he was stationed at Goa, in 1809, he lived, as many others did, in a cocoa-nut leaf-house; and that, although the period was in the very height of the monsoon, and the house was on the sea-coast, it was comfortable and warm. He believes that not a nail was used in the whole building; the rafters, supporters, &c., were fastened on with string made of the fibrous envelope of the cocoa-nut shell; the

* Flinders' Voyage, vol. ii. pp. 115, 116.

† Forster's Voyage, pp. 14, 15.

wood was the tree itself; the roof, walls, doors, and windows, were formed of the leaf. From the same authority, we learn, that the fibres, enveloping the shell of the nut, have frequently been woven into a cable, by which ships of seventy-four guns have safely rode out heavy gales of wind, when European cables have parted.*

It is said by other authors, that the leaves of this tree serve for food to elephants; and that the ashes of the wood contain so great a proportion of potash, that the native fishermen of Ceylon use them instead of soap. But those properties of the cocoa-nut tree, which, in the view we are now considering, are the most admirable, are the qualities of its fruit, as an abundant and useful article of food. We are informed, that the tree yields produce twice or thrice in the year; that it is fruitful from its eighth to its sixty-fourth year; that it sometimes bears a hundred nuts annually; and that it is to be found in such quantities, that, in the year 1813, the numbers in Ceylon, along a line of coast of about 184 miles, were not fewer than ten millions.

The half-ripe nut contains sometimes three or four pints of a clear aqueous fluid, fragrant and pleasant to the taste; and the nut itself, from its highly nutritious qualities, is used as an aliment in all intertropical countries.† If the extremity of the sheath, from whence the flowers of the cocoa arise, be cut off while young, a white sweet liquor distils from it, as well as from other palms, which is used extensively as a beverage in India, under the name of *palm wine*. This liquor, if concentrated by boiling, deposits a sugar;—if exposed to the air, it acquires vinous properties at the end of twelve hours, and, at the end of twenty-four hours, becomes vinegar. An oil may be obtained from the nut, which is not inferior to sweet almond-oil, and which is used almost exclusively in India. The shell is formed into cups, and various other small articles.‡

* Ellora, p. 283.

† Wern. Mem. vol. v. pp. 110.127.

‡ Nouv. Dict. de Hist. Nat. tom. vii. p. 297.

The remarkable properties I have detailed, cannot be viewed without recognizing the hand of a beneficent and provident Creator, who has not only bestowed this abundant and varied blessing on the originally habitable earth, but, foreseeing the formation of new islands, from the depths of the wide ocean, the produce, in remote ages, of minute animalcules, gifted this vegetable production with every quality, which might render it useful to the human beings who should be cast on these solitary coasts; and, fitting it to spring from a half-formed soil, provided it, in its buoyant and thickly-coated shell, with a boat, in which it might be wafted by the winds, the waves, and the tides, to such distant localities. The ways of the Almighty are always wonderful; but there is something in these adaptations of different departments of Nature, to preserve the lives, extend the numbers, and promote the comforts of human beings, which fills the mind with amazement and devout adoration.

TENTH WEEK—TUESDAY.

MITIGATION OF SEASONS OCCASIONED BY CULTIVATION.

It is exceedingly edifying to examine, in all its phases, the nature of that discipline, by which Providence trains the human race, and the character and extent of those means, by which their moral and physical powers are stimulated, and the exercise of these powers is rewarded. I have already taken various opportunities of calling the reader's attention to this subject, but it recurs continually, and the more it is examined, the more interesting it becomes. It has been truly said, that 'the hand of the diligent maketh rich.' But this is not the only, nor indeed the chief, reward of a well-directed and properly-regulated industry; it also promotes the health, and improves the understanding, and thus stamps with the seal of

truth the homely adage of poor Richard, which is in every body's mouth—

> 'Early to bed, and early to rise,
> Makes a man healthy, wealthy, and wise.'

But even this is very far from being the whole of the blessing which Providence has annexed to habits of activity and attention to the various callings of life. The advantages acquired by individuals are extended to society, and thus the necessaries of life become more abundant, and its comforts and conveniences are, both directly and indirectly, promoted in a thousand different ways. Nature itself seems to become more propitious under the ingenuity and laborious exertions of man, and to relax in her more rigid features, as society advances in civilization.

I have, at present, chiefly in view some remarkable facts, in reference to climate, which seem to prove that it is affected, in an extraordinary degree, and in a very salutary manner, by the cultivation of the soil. Evaporation is a well-known cause of cold, the conversion of water into vapour being necessarily attended by the absorption of much heat; and whatever promotes the one, must, at the same time, have a tendency to increase the other. Now, a great part of the Continent of Europe was anciently overrun with immense forests, which produced this effect, by their leaves and branches exposing a large surface to the action of the air; while, at the same time, they diminished the power of reflection, by intercepting the direct rays of the sun. Another and very extensive cause of excessive evaporation in uncultivated grounds, is the existence of swamps, and of large tracts of land overloaded with moisture. Cultivation has the effect of diminishing these sources of cold, by the clearing away of the woods and the draining of the soil, both of which operations have actually been performed in Europe to a great extent; and the change, which has thus been produced, is greater than, independent of experience, could easily have been anticipated. Hume, in his 'Essay on the Populousness of An

cient Nations,' has investigated this subject with his usual acuteness, and has brought together some curious facts, which show that the European climate is now much milder than in early times. Italy, for example, has at present so warm a climate, that winter frosts are almost unknown. It was not so formerly. Horace speaks familiarly of the streets and neighbourhood of Rome being frequently covered with snow and ice. In the year of the city 480, the winter was so severe, that the Tiber was frozen firmly over; the trees were destroyed by the intensity of the cold; and the ground was covered with snow for forty days. This was, indeed, an unusual occurrence; but Juvenal, in describing a superstitious woman, represents her as breaking the ice of the Tiber, that she might perform her ablutions;* and he speaks of that river freezing over as a common event,—a circumstance which never happens in the present day. In other parts of Europe, a similar difference is indicated. Gaul was anciently represented as a most inhospitable climate. Petronius proverbially speaks of something being *colder than a Gallic winter.* Aristotle says, that the climate of Gaul was so cold, that an ass could not live in it. Diodorus Siculus describes it in similar terms. He speaks of its extremely severe northern climate, where, in cloudy weather, snow falls instead of rain, and, in clear weather, the rivers are frozen so hard that large armies may pass, with all their baggage and loaded waggons. Strabo states, that the northern parts of Spain are thinly inhabited, on account of the great cold. Varro speaks of the inland countries of Europe, as invested with almost perpetual winter; and Ovid mentions the Euxine as, in his day, frozen over every year.

On comparing these accounts with the state of the European climate in modern times, we cannot fail to observe a most striking and general amelioration; and we need not hesitate in attributing the change to the effects of agricultural improvement. The climate of North America is, from the

* Hybernum, fracta glacie, descendet in amnem
Ter matutino Tyberi mergetur.—Sat. vi. 523.

same cause, becoming gradually less severe, and assimilating itself to that of Europe. Wherever the ground is extensively cleared of wood and cultivated, the mildness and salubrity of the weather is materially increased.

These remarks on the effects of cultivation, as producing a salutary influence on the climate, during winter, lead us to notice a not less important change, effected by the same cause, in the other seasons of the year. When the earth is barren, the alternations of heat and cold, and of rain and drought, are very violent. A vigorous but not prurient vegetation has a wonderful tendency to correct these injurious excesses, and, by diffusing the temperature and moisture more equally, to render such agents at once the means of additional fertility to the soil, and health to the human constitution.

In adverting to this subject, it is impossible not to remark, as a peculiar proof of beneficent design in the Author of Nature, that of all the vegetable productions, none tend so much to promote this beneficial result, as those which are cultivated for the food of man, and the domestic animals. 'By the shade which they afford to the ground in the hot season,' says an intelligent writer, to whom I am indebted for some of the above observations, 'they check that evaporation, and prevent that excessive hardening of the surface, which, in an exposed wild, render the soil impervious and inert; while, on the other hand, the humidity, which they imbibe during the rainy season, is again given out, by continual and gradual evaporation, and they minister to the refreshment and productiveness of all around them.'*

To prove the unmitigated action of the elements, in regions destitute of cultivation, the same author refers to the present state of some parts of India, of Southern Africa, and of Australia, where, at one time, the earth is parched, and the beds of rivers become dry channels, or unconnected pools; while, at another, they suddenly pour onward to the sea, in a wide-spreading inundation, or roll their rapid floods in narrow but deepened channels; and, to show how powerfully these evils

* Library of Entertaining Knowledge, vol. xv. Introduction.

are modified by human industry, he mentions the remarkable change which, even within the memory of man, has taken place in those parts of Scotland where agriculture has, during the last hundred years, been rapidly improved. 'It is within the experience of persons still living,' says he, 'to have noticed that the snow, which, in that country, began to fall in November, was not wholly gone till the month of April; while, in the middle of summer, the heat was so excessive, that agricultural labourers were obliged to suspend their toil during four or five hours in the middle of the day. At that time, the autumnal rains frequently descended with so much violence, that the crops, which had been retarded by the coldness of the spring, were prevented from ripening on the high grounds, were lodged and rotted on lands that were lower, and swept away by the swelling of the streams over the holms and meadows.'

Though the above account may perhaps be justly said to be somewhat overcharged, yet the mitigation of the Scottish climate, in all these particulars, is well known, and is wholly to be attributed to the progress of agricultural improvement. This has had a very salutary effect on the health of the inhabitants, as well as their means of subsistence, and may be fairly stated as a striking instance of the nature of those blessings which Providence has so bountifully, and in such a variety of ways, annexed to human industry.

TENTH WEEK—WEDNESDAY.

THE LABOURS OF THE HUSBANDMAN WISELY DISTRIBUTED OVER THE YEAR.

The wonderful adaptation of organized existences, both animate and inanimate, to the seasons of the year and the cosmical arrangements of the globe, on which it has pleased Providence to place them, has already been noticed.* But

* See '*Winter*' Volume, Fourth Edition, p. 70. Paper 'Adaptation of Organized Existences to Seasons and Climates.'

there is one remark which has not yet been made, and which tends not only to illustrate our general argument, but to show that the more minutely we observe the features stamped upon the system of which these existences form a part, the more reason we have to admire the nice and well-considered adjustments which it invariably manifests. The particular to which I now allude, refers chiefly to the variety that exists in the proper seasons of germination, and in the periods necessary to the ripening process, in such of the vegetable productions as are useful to man, and are raised by his labour. By far the larger proportion of them require only one season to bring them to maturity, being sown and reaped in the course of a single year; but, among them all, there are not perhaps any two which occupy precisely the same number of weeks, or which need to be sown and reaped precisely at the same seasons. Late in autumn, and during the months of spring, they are all committed to the earth, and begin to vegetate, continuing to increase through the heats of summer, till they are at length gathered in for the sustenance or the comfort of man and his dependants.

Now, let it be remembered, that, in a densely-peopled territory like our own, there is no such thing as a spontaneous production, to which the wants of the human race and the domestic animals can be intrusted. Were man to cease from labour, the earth would soon refuse to yield her increase; and there is a proportion thus established, in every country, between the amount of industry, judiciously applied, and the number of the animal creation, which the soil is capable of nourishing. The favourable rate of this proportion to animal life which at present exists, however, as will immediately be seen, is very dependant on the variety to which we have alluded in the periods required to bring the useful vegetables to maturity.

We could easily imagine an arrangement to be established, by which the progress of the annual fruits of the soil from germination to maturity, should not only be precisely adapted to the solar year, as we have seen them to be, but should each

have to run a precisely similar course ; the seeds of them al. requiring to be sown at the same period of the year, and swell ing and bursting together ; the young blades and stalks, and leaves and roots, in them all, advancing with equal rapidity through the months of summer, and all of them arriving at a state of ripeness at precisely the same period. Such an order of things, it is clear, would require the husbandman so to arrange the operations of his farm, that the soil might be ready at the same particular time in spring, for the reception of every variety of grain and other seed, the produce of which he might desire to reap in autumn. The deviation of a very short period, in committing any of them to the soil, must, it is evident, on this supposition, necessarily derange the progress of the vegetable fluids, and endanger the safety of the crop ; while the risk arising from a want of punctuality in spring, must be very greatly increased by neglecting to seize the proper period for gathering in at last the ripened produce. Now, what must have been the effect of all this upon the operations of husbandry ? Nothing can be more evident. The labours of the spring and of the harvest being, in each case, crowded into a few weeks, must have been hurried forward with tenfold precipitancy. A vast accession of hands must have been required to accomplish the work within the prescribed time ; and the extraordinary exertion once over, several months would necessarily elapse without any serious labour being requisite, or any adequate occupation presenting itself for the general population. Some idea of the difficulties which must have attended such an order of things, may be formed by the agriculturist, who has experienced the inconveniences arising from the simultaneous ripening, which sometimes occurs, even of but one principal crop. He has found the necessity of summoning to his aid the whole available population of hamlet and cottage, and has discovered, to his disappointment, that his neighbours around him, having felt the same need, have already forestalled him in the market, and drained the ordi nary physical resources of the whole district ; so that it is only by offering an exorbitant inducement that the old, or the fee-

ble, or the very young, or the independent, can be brought to do the work, which would have been both better and more cheaply performed by other hands, had the season been less precipitate, and the ripening process more gradual. The subsidiary force that can be called out on such extraordinary occasions must always be limited; and it has sometimes occurred, that the farmer has been obliged, with pain, to witness the destruction of his finest crops, merely because he could not command a sufficiency of labour in time to secure them, ere the period of ripeness had given place to that of over-maturity and decay.

On the supposition which has been made, therefore, were it possible to give the plan a fair trial, it is very obvious, that the first requisite would be an immense increase of population, to carry on the business of agriculture. Now, what would be the immediate consequence of this? The equilibrium that now exists between the number of mouths and the amount of edible produce, would be overturned; the land would fail to support the people necessary to its culture; these would die in large multitudes from starvation; the soil, in turn, would languish; in the second year of the experiment, its resources, thus still further curtailed, would prove inadequate to afford even the diminished quantity of sustenance which would be required; and at what point short of utter desolation, the destructive effects of the arrangement would cease, it is not easy to form any idea.

How much better and wiser, then, is the system which we behold actually at work on the face of a cultivated country like our own. When we set out with the husbandman, after the conclusion of his harvest labours, which may be aptly styled the commencement of the agricultural year, and follow him as he proceeds through the varied duties of the whole cycle, till we arrive with him at the same point in the following year, from which we had begun in the preceding, we observe that there is a perpetual alternation of employments, by which the amount of labour required upon the farm, at each period of the year, is pretty nearly equalized. One descrip-

tion of agricultural produce requires a longer union with the soil than another. Wheat, for example, should be sown in autumn. Oats ought not to be committed to the earth till March. Barley must be delayed still longer; while potatoes may be planted in May, and turnips drilled in June. This variety in the periods of seed-time, is not more remarkable than that which occurs in those of ingathering. The first principal crop reaped in this country is rye-grass, upon which the sustenance of several of the valuable animals reared and employed upon the farm mainly depends. Mowing commences in June; and no sooner has this crop been secured, than the natural hay of the meadows demands the attention of the husbandman. Hard upon this crop follows the ripening of the various descriptions of grain, differing from one another in their periods, and the early and late varieties of each contributing still further to spread the process over a considerable proportion of autumn. The joyous harvest home closes the year.

The distribution of the labours requisite for the cultivation of the soil, however, beautiful as it is, does not so perfectly equalize the exertions of the several seasons, as to afford no periods of relaxation from the regular business of the farm. The arrangement produces only an approximation to this state, and an approximation is all that is required. There are many short seasons intervening, of which the farmer knows well how to take advantage for securing fuel, cutting drains, rearing fences, forming embankments, and superintending other operations, which can be performed during any part of the year, when the duties peculiar to the several seasons cease to demand attention. Nor is there wanting to the agricultural labourer a time of innocent relaxation and mirth; for, during the frosts of winter, when the hills and valleys are bound with ice, and the plough can no longer penetrate the surface of the ground, he can lay aside for a little his daily labours, and improve his mind by reading, or exhilarate it by social intercourse, thus unbending from the rigours of his la-

borious life, and by a few days of useful or innocent amusement, lightening the toil of a whole year.

G. J. C. D.

TENTH WEEK—THURSDAY.

THE CORN-PLANTS.—THEIR MYSTERIOUS ORIGIN.

THE various productions which are the objects of culture so far as the business of the agriculturist is concerned, may be divided into such vegetable substances as are fit for food, such as are employed in manufactures and the arts, and such as are used merely for the shelter and subdivision of the lands. In the earlier stages of agriculture, the first alone would be attended to; and of these the most important are the cereal plants, or the various kinds of grasses, known by the name of corn. These productions are not less agreeable to the palate than salubrious to the bodily health; and, while they thus indicate the paternal care of the great Creator, who has made so bountiful a provision for the wants and comforts of man, the circumstances which attend their propagation, afford instances equally striking, of a wise and liberal attention to the moral improvement of the human species. It is not merely that the possession of such grateful food essentially affects the extent of the population, as well as their health and animal vigour; but that the various employments necessary for its successful cultivation, have an obvious tendency to call forth and encourage the exertions of a virtuous industry. The crops of the sluggard are overrun with weeds, stunted in their growth, and deteriorated in their wholesomeness; while the labours of the diligent are rewarded, not only by a material augmentation in the quantity, but also by a not less remarkable enhancement in the quality, of the produce. In the evidence given by the Roman Catholic Bishop, Dr. Doyle, before the Committee of the House of Commons on the Irish

Poor, there is an instructive passage which bears on this subject, so far as regards the article of potatoes. He distinctly states, that in consequence of the slovenly manner in which that crop is cultivated by the labourers in the crowded districts of Ireland, a very striking change for the worse has taken place in the nutritive qualities of that useful plant. In this instance, peculiar circumstances have afforded an opportunity for making the observation, which seldom exist to the same extent elsewhere; but, if any one will take the trouble of inquiry, he will be surprised to discover how distinctly a similar effect is produced, both on grain and roots, in every part of the world where agriculture prevails.

To the plastic power of agricultural industry, in modifying and transforming the produce of the soil, we perhaps owe a remarkable fact of a different kind, which has deservedly attracted the attention of the students of nature. I allude to the circumstance, that no researches which have yet been made, have been able, distinctly, to trace the origin of the various species of grain now forming the staple of the agriculturist. There seems, indeed, good reason to believe, that nowhere on the face of the earth do any of them exist, in a wild state, with such properties as they possess under cultivation; unless, indeed, we make an exception in favour of Persia, where wheat has been found springing up spontaneously on spots now remote from human habitations—a remnant in all probability of the cultivation of ancient times. So true is this, that no surer indication can be found of the agency of civilized man, than the production of corn-plants, in any quarter of the world. Some species of cultivated grain, indeed, such as barley, are said to have been proved, by experiment, to be totally incapable of propagating themselves through a series of years, even under the most favourable circumstances;—a fact which, if it can be relied on, adds greatly to the mystery hanging over the original production of corn. Whatever light future discoveries may throw on this curious subject, it is impossible to view it without some degree of religious awe. Had the corn-plants been indigenous, or even had we been able to trace their

origin to distant climes, we might have been less deeply impressed with the agency of Heaven in bestowing these necessaries of life, and have regarded their cultivation as the mere ordinary effect of human industry; but it does throw a sacredness around the subject to be informed, that we possess these precious gifts, without being able, by natural means, to account for the manner in which they fell into our hands; that their very existence depends, year after year, on their cultivation; and that, should man cease, but for a short interval, to avail himself of the blessing, it is scarcely too much to aver, that the whole species of grain, with the exception, perhaps, of wheat in some peculiar circumstances, would perish from the face of the earth! When these facts are considered, it cannot be matter of surprise that, in all rude countries, traditions prevail, which attribute the origin of these necessaries to the direct interference of a divinity. Nor does it greatly lessen the admiration with which we contemplate this subject, to hear that attempts, some of which are said to have been partially successful, have been made, by scientific men, to transform certain wild grasses into cultivated corn. It may be true that the *Oegilops* of Sicily might, by careful and long cultivation, be changed into wheat; but this does not remove the mystery, even with regard to that single class. The question still recurs, by what remarkable incident, or rather series of incidents, in the earliest ages of the world, was this change effected, and by what extraordinary concurrence of circumstances was the discovery so carefully preserved, and so universally propagated.

We affect not to say, that the gift was miraculous, in the ordinary sense of that word; but we cannot resist the conclusion, that there is here conspicuously displayed the footsteps of a beneficent God. If, in the present advanced state of science, and of agricultural as well as commercial activity, there appears to be scarcely any means by which, on the supposition that all the grain now under actual cultivation were destroyed, the loss could be supplied from the common storehouse of nature, it cannot but be esteemed a cause of more

than ordinary gratitude to the Giver of all Good, that we have, in some mysterious way, been put in possession of articles of food so essential to human subsistence and happiness; and if it be also true, that the constant care of man is absolutely necessary, not merely for rendering this boon available for his use, but even for preserving it from almost certain annihilation, an additional force is given to the religious sentiment, which the contemplation is calculated to excite.

There is a natural infidelity of heart in man, which such facts tend to detect and to rebuke. In the more stable arrangements of Providence, if we may term them so, which do not at all depend on human exertions, we are apt to see nothing but the operation of mechanical powers. The grass springs spontaneously; the tree propagates its species by a natural process; the seasons revolve, and the ordinary fruits of the earth undergo a regular alternation of decay and reproduction, depending on what are called physical laws, certain and invariable in their operation, and altogether unconnected with human agency. These, though in reality not less indicative on that account, of Divine power and wisdom, yet, to a superficial observer, do not stand so prominently forward among the evidences of a superintending Providence, and he sees nothing in them, perhaps, but a curious train of natural sequences. The effect must be different, when we can demonstrate to him the astonishing fact, that the ordinary necessaries of life are maintained in existence by no such natural laws. That they neither exist, nor can be available, without the intervention of human industry; that, although assuredly not the creatures of man's invention, they depend entirely on his care for their preservation; and that thus, while there is, in the very constitution of the corn-plants, a proof of the curse which doomed man by a stern necessity to labour for his subsistence, there is also a proof, not less striking and conclusive, of the paternal tenderness which mingles favour with the chastisement, and from its very infliction elicits a reward.

TENTH WEEK—FRIDAY.

VEGETABLE SUBSTANCES.—THE CORN-PLANTS.—THEIR DISTRIBUTION OVER THE GLOBE.*

All vegetable productions, used as food, contain what is called a farinaceous, or mealy substance, admirably adapted for the support of animal life. This substance, indeed, serves in a greater or less degree, to form a constituent in all plants, and to be necessary to their growth. It has less of an organized structure than is discoverable in the membranous and fibrous portions of vegetables; and, when dry, may be converted into flour or meal. There are two kinds of vegetable substances which are best adapted for food, because, when ripe, they contain the greatest quantity of farinaceous matter; these are seeds and tuberous roots. It is of the former that I at present speak; and indeed of only one division of these productions, since that of *pulse*, or legumnious seeds, as well as of tubers, will form the subject of future consideration.

The corn-plants (*cerelia*), or grain-bearing plants, are true grasses, annual in their growth, having a hollow straw or culm, divided by joints or knots, and dying, both in the stems and roots, after the seed has ripened. The head or ear consists of an uncertain number of flowers, followed by seeds, and in these seeds the farinaceous food is deposited.

The chief corn-plants are wheat, rye, barley, oats, millet, rice, and maize; but there are other varieties, which might be employed as food, and which are only neglected on account of the smallness of their seeds. 'None are unwholesome in their natural state,' says Lindley, 'with the single exception of *Lolium temulentum* (darnel), a common weed in

* For the principal facts in these consecutive papers on Vegetable Substances, I am indebted to the elaborate and useful treatise on this subject, contained in the Library of Entertaining Knowledge, of which I have made free use. This acknowledgment will prevent the necessity of constant reference

many parts of England.'* The distribution of the above mentioned plants, over the various regions of the earth, as affording a proof of beneficent provision, shall form the subject of this paper.

None of the cereal plants seem capable of being raised to advantage in a higher latitude than about thirty degrees from the pole. This may, therefore, be considered as the limit of agricultural labour in the northern hemisphere, while, in that of the south, it is still more limited. Providence, however, has afforded other means of subsistence, as we have seen, to the living creatures who border on the polar circles, or who have penetrated within them. In Siberia, while grain is partially cultivated up to the sixtieth degree, the more southern districts of that extensive region, especially those which the Wolga waters, exhibit an extraordinary degree of fertility. Buckwheat is commonly raised in these parts, and it is found that one sowing of the seed will produce five or six crops in as many successive years; the seed which is shed during the reaping, sufficing to insure a crop in the subsequent season, without any manure, and with no more labour than that of harrowing the land in spring. The inhabitants are nevertheless poor, the means of commercial intercourse being extremely deficient.

Barley and oats are the kind of grain, the culture of which extends farthest to the north, in Europe. Rye follows next in order, being associated with oats and barley in the more northern division of the temperate zone. In the southern parts of Norway and Sweden, in Denmark, in districts bordering on the Baltic Sea, and in the north of Germany, rye forms the principal object of cultivation, barley being raised in those countries, as in England, only for the purpose of brewing, and the use of oats being limited principally to the feeding of horses. Wheat is also grown in those countries, but chiefly for exportation. In such northern regions, vegetation, when once commenced, proceeds with extraordinary rapidity. In Sweden and Norway, barley is generally sown

* Introduction to the Natural System of Botany, p. 302.

and reaped in the short space of sixty days; and, in some of the Norwegian provinces, that crop has been known to be fit for the sickle, even in six weeks after it was deposited in the ground.

Somewhat farther to the south, rye becomes more rare, and is succeeded by wheat as the principal material used for human food. France, England, the southern parts of Scotland, part of Germany, and Hungary, and the lands of Western and Middle Asia, as well as some districts of North America, fall under this description. In some of these countries, the vine is also cultivated, and the use of wine, instead of beer, causes the neglect of barley.

Still farther southward, maize and rice come into cultivation along with wheat, and enter largely into the constituents of human food. Portugal and Spain, that part of France which borders on the Mediterranean Sea, Italy, and Greece, are thus circumstanced.

Eastward, in Persia, Northern India, and Arabia, and southward in Nubia, Egypt, and Barbary, wheat is indeed found; but maize, rice, and millet, form the principal materials for human subsistence. The grains which form the chief objects of cultivation in our division of the globe, are rarely seen in China and Japan, owing, it is believed, more to the taste of the inhabitants, than the character of the soil and climate. There, the staple production for food is rice. In that empire, agriculture is greatly encouraged; and even the emperors of China have not disdained to hold the plough, and place their fame on the basis of agricultural improvements. The well-known denseness of the population in these regions may be considered as both the cause and the consequence of this feature in the national character.

Of the countries which lie between the tropics, those of Asia adopted principally the use of rice, while maize is the common food of the Americans. For this distribution there exists a natural reason,—Asia being the native region of rice while America is that of maize. In mosts parts of Africa,

the two grains are used indifferently, and in nearly equal proportions.

In America, which comprises climates analogous to those in every other quarter of the globe, we find all the varieties of grain culture I have already enumerated. The highest limit for the cultivation of the cereal plants is to be found in the southern part of the Russian possessions in that great continent, situated between 57° and 58° of north latitude, where barley and rye are brought to maturity. In the more eastern parts, the same cultivation rarely succeeds higher than 50° or 51°. In Canada, and in the northern parts of the United States, barley, oats, rye, and wheat, may be cultivated as successfully as in Europe; but the agriculture is much more slovenly, owing, doubtless, to the extent of thinly peopled territory. Maize, and in the southern parts, rice, are very extensively raised within the bounds of the Union.

On the table-land in southern latitudes of the Mexican Republic, the corn-plants of Europe are cultivated, but never at a lower elevation above the level of the sea than 2500 or 3000 feet. In the regions of Mexico, of a lower level, maize is extensively raised; and, from the nature of the climate, and the fertility of the soil, the returns are most abundant, sometimes yielding a harvest of two hundred for one.

In the temperate and polar districts of the southern hemisphere, the order of cultivation is very similar to that pursued in corresponding latitudes and elevations north of the tropics. In the southern provinces of Brazil, in Buenos Ayres, and in Chili, as well as at the Cape of Good Hope, and among the settlers in Australia, wheat forms the principal object of cultivation. In Van Dieman's Land, barley, rye, and oats, are also to be found.

This hasty sketch may serve to show, without any remark, how beneficently the Creator has suited some one or other of the various kinds of grain to all the productive climates of the earth, and how remarkably the constitution of each is adapted to its own locality, the one class intermingling with the other at the various lines of contact, so as to leave no region of the

earth without its wholesome and appropriate food. This will appear more distinctly, in treating of each species separately.

TENTH WEEK—SATURDAY.

THE CORN-PLANTS.—WHEAT.

The nature of this work will only admit of some slight notices of the most remarkable articles of agricultural produce; and of these I begin with wheat, as the species of grain held in highest and most general estimation.

The peculiar property on which the value of this plant depends, next to the quantity of farinaceous food which the seed contains, is its extraordinary power of multiplication, increasing in proportion to the care employed in its cultivation. In the Philosophical Transactions,* it is recorded, that Mr. C. Miller of Cambridge sowed, on the 2d of June, a few grains of common red wheat, one of the plants from which had tillered† so much that on the 8th of August he was enabled to divide it into eighteen parts, all of which were placed separately in the ground. In the course of September and October, so many of these had again multiplied their stalks, that the number of plants which were separately set out to stand the winter, was sixty-seven. With the first growth of the spring the tillering again went forward, so that, at the end of March and beginning of April, a further division was made, and the number of plants now amounted to 500. Mr. Miller thought that before the season had too far advanced, another division might have been made, when the number would have been at least quadrupled. This, however, was

* Vol. lviii.

† To *tiller*, technically signifies to throw out stalks, not from the germ, but from various points of the infant sprouts, while yet they remain in contact with the moist soil.

not done; but the 500 plants proved extremely vigorous, much more so than wheat under ordinary culture, so that the number of ears submitted to the sickle was 21,109, or more than forty to each of the divided plants. In some instances there were not fewer than 100 ears on one plant. The ears were remarkably fine, some being six or seven inches long, and containing from sixty to seventy grains. The wheat, when separated from the straw, weighed 47 lb. 7 oz., and measured three pecks and three-quarters, the estimated number of grains being 576,840.

Such an enormus increase is not, of course, attainable on any great scale, or by the common modes of culture. But the experiment serves to show the vast power of reproduction with which the Creator has endowed this most valuable of vegetables; and leads us to comprehend, how, by judiciously varying the mode of culture, the produce may be rendered more adequate to supply the wants of a growing population; or, at all events, how, under some peculiar circumstances, such as that of a ship's crew being cast on a desert island, the possession of a single grain of wheat may, in a very few seasons, be made to contribute to the support and comfort of a considerable number of individuals.

The ordinary produce of wheat varies exceedingly, being made to depend, not merely on the quality of the soil, and the nature of the season, but on the mode of culture,—a provision intended, doubtless, to stimulate and reward industrious habits. The average production of the soil, in any country, depends on the advance of its inhabitants in knowledge, and in the possession of capital. It has been conjectured, that, in the thirteenth century, an acre of good land in England would produce twelve bushels of wheat.* In two centuries, this rate of produce appears to have greatly increased. Harrison, writing in 1574, says, that on an average,† 'each acre of rye or wheat, well tilled and dressed, will yield commonly sixteen

* Eden's History of the Poor, vol. i. p. 18.

† This I understand by what he calls 'meane and indifferent years, signifying, in more modern language, medium and common years.

or twenty bushels; an acre of barley six-and-thirty bushels; of oats and such like, four or five quarters; which proportion is notwithstanding oft abated towards the north, as it is oftentimes surmounted in the south.' The mean produce, in Great Britain, did not, according to the estimate of Mr. Arthur Young, when he wrote (about half a century ago), exceed twenty-two and a half bushels per acre. It is constantly on the increase, and other and later writers have calculated the average at from twenty-four to twenty-eight bushels.

At the time of the Revolution, according to the estimate of Gregory King, fourteen millions bushels of wheat were grown in England. In 1828, according to the estimate of Mr. Jacob, in his tracts on the Corn Trade, twelve millions five hundred thousand quarters, or a hundred million bushels were grown. The population of England, at the Revolution, was under five millions, so that each person consumed about three bushels annually. The population, at the present time, is under fifteen millions, so that each person consumes about seven bushels annually.

Extraordinary success in agricultural labours has sometimes been the means of exciting, not only the envy, but the superstition of a neighbourhood. A case of this kind is related by Pliny, as having occurred among the Romans. Cresinus, he tells us, was cited before an assembly of the people, to answer to a charge of sorcery, founded on his reaping much larger crops than others, from a small spot of ground. 'In answer to this charge, Cresinus produced his efficient implements of husbandry, his well-fed oxen, and a hale young woman, his daughter, and pointing to them, he exclaimed, "These, Romans, are my instruments of witchcraft; but I cannot here show you my labours, sweats, and anxious cares."'*

We have seen how wheat is multiplied by means of tillering, an operation which takes place under ground; and I cannot help mentioning a curious fact, with reference to this subject, which seems to discover a new and remarkable adaptation

* Nat. Hist., book xviii. chap. vi.

between the vegetable and animal world. There is an insect,* which is accustomed to deposit its eggs in the very core of the *plumula*, or primary shoot of wheat, so that this shoot is completely destroyed by the larvæ. Did the plant possess, within itself, no means of repairing this injury, the whole previous labour of the husbandman would, in this case, have been in vain. But this destruction occurring in the spring of the year, when the vegetable power of the plant is in its greatest vigour, an effect is produced, somewhat analogous to that of heading down a fruit tree. Shoots immediately spring up from the knots; the plant becomes more firmly rooted, and produces probably a dozen stems and ears, when, but for the temporary mischief, it might have sent forth one only.

There is here a most curious and beneficent deviation from the ordinary law by which Creative Wisdom seems to have been actuated in the formation of the insect, and, indeed, I may say of the whole animal world. That law is, that, while the living creature finds subsistence for itself in the vegetable kingdom, it should tend to preserve the balance among its various productions, by the destruction, or at least injury, of the plant on which it feeds. Here, however, the very reverse is the case; and a similar remark may be made with regard to the various grasses, which form the food of herbivorous quadrupeds. The grazing of these animals, though it destroys the seed-stalk, causes the plant to tiller, and thus compensates for the loss sustained in the power of propagation, by forming on the spot a firm, sweet, and luxuriant sward of herbage.

That the very same law, which keeps in check other vegetable substances, should be made subservient to the increase of those which are of essential importance to the subsistence of the higher species of animals, is a benevolent intention, which cannot be mistaken, and which it is impossible to perceive, without admiration.

* Musca pumilionis.

ELEVENTH WEEK—SUNDAY.

SABBATH MORNING.

THERE is no season more welcome to the Christian, than the dawning of the day of rest; none that is ushered in with more reviving associations.

The sun, drawing up the soft vapours of morning, seems to shine with a more cheering light on the day that saw the rising of the Sun of righteousness. The moist green turf, spread as a carpet over hill and dale, catches the bright reflection, and returns a grateful smile; while the clustering wild-flowers that spring from its shelter, show forth the beneficence that did not scorn to fashion their short-lived beauty. The breezy air seems to breathe the messages of gentleness and mercy from forgiving Heaven; and the earth, once smitten with a curse for the sin of man, seems to partake in the reconciliation that was completed on the Saviour's resurrection morn. The fields and the woods send up their sweetest incense, and the trees rustle, and the waters murmur, praise. Spring, the season of Nature's hope, brings not so bright a day as this, the time of peculiar and more enduring hope to the Christian. As his eye rests on each feature of the scene, his heart becomes filled with its serenity, and he exults in the service of so gracious a Master. If he sees love in the colouring of the landscape, and the arching of the sky, how unspeakably greater does that appear which rescued him from destruction, and adorned his fallen and polluted soul with the spotless robe of imputed righteousness. Corrupted, and at enmity with God, it was gently drawn from the brink of ruin, and was purified and formed anew, while it wondered and gave thanks at the mighty work of the Divine Spirit. Of the same love, the institution of the sacred day is a rich token. Like the gourd that sprung up to shelter Jonah from the scorching heat, the services of the sanctuary have been

prepared for the refreshment of the heaven-bound pilgrim;—but not, like it, to perish in a night: For, ever, as the first day of the week returns, are these solemnities renewed, and their hallowed influence is felt to extend over each intervening day. The prospect of a day spent in the courts of God, sheds a tranquil joy through the soul, and calls forth the fervent exclamation, 'How amiable are thy tabernacles, O Lord of Hosts!' And what the heart desires, it seeks with earnestness from Him whose presence alone makes glorious the places of His rest on earth.

And shall the morning contemplation cease here? Shall the Christian, absorbed in his own joyful prospects, forget the multitudes to whom the Sabbath brings no joy? Never does their wretched state come with more energy to his mind, than in that hour of thankful peace. In proportion to the vividness of his own hope, is his conviction of the awful hopelessness of the unconverted. He mourns for the many who live like him under the shadow of the Cross, but cling not to it;—the many who are led to the streams of Gospel privilege, but will not drink, and live. To them the Sabbath is a weariness; they go up to the sanctuary with indifference, and leave it without profit. Years are rolling on, and soon their places will be vacant; and soon again they will be filled by another generation. And where will be those who have despised the offers of pardon, and refused to hearken to the reiterated calls of mercy? As the Christian muses on these things, he is stimulated to arise and be doing, while yet it is his privilege to sojourn where a work so vast and so important lies before him. Is it time to rest in his own happiness, or to seek his own honour, when souls are perishing? It would be greater joy to him to win one rebel back to his allegiance, than to attract the admiring gaze of nations, or to be crowned with the freshest laurels that ever bound the brow of a Cæsar.

Those, too, he remembers, more ignorant, but less guilty than the former, who dwell far off on the islands of the sea, or in regions of unexplored darkness, in the burning deserts of Africa, or among the tangled forests of the West. On

them the morning sun may arise in his glory, but it is only to light them onward in a course of sin. Spring may spread her most luxuriant wreaths around their rude dwellings, but the desolation of unbroken winter broods on their immortal souls. The trees of the forest, or the caverns that shelter the beasts of the earth, furnish them with nutritious food; it was provided by no skill of theirs; but they know not the hand that maintains the ready supply,—they see not the traces of Him whose paths drop fatness. In their ignorance they give thanks to dumb idols, and in their deep groves, or by their silvery streams, to them present their offerings; but these cannot hear their cry in the hour of their anguish, or illumine for them the gloom of a dark, unknown eternity. The Sabbath passes and returns, but brings no rest to them. There is no early bell to call them to the house of prayer, no faithful shepherd to collect the flock,—the beautiful flock,—who are scattered through the wilderness, an easy prey to the devouring Lion. It is the hour of that Lion's exultation, and he deems the empire all his own; ages have mingled with eternity, and yet, mysterious dispensation! his terrible sway has not been broken down. But the day approaches; for these benighted ones are precious in the sight of Him who feeds the ravens when they cry, and He will come in His might, to make the crooked places straight before them. The Christian has been furnished with a powerful engine to accelerate that day; and he whose bosom glows with heavenly zeal, will never cease to use it. He will offer many prayers on the altar of the covenant, and, in due time, all shall receive an answer, even tenfold more than his heart could conceive. Taught, by a Saviour's love, to pity the perishing, he will, as He did, entreat the Father for them, and strive to excite in others a corresponding fervour, that all, uniting under the banner of the cross, may spread the glad tidings of salvation over the length and breadth of a ransomed, but still enfettered world.

True religion is not selfish; it expands the heart to love, and nerves the frame to action; and the Christian goes forth

from the hour of Sabbath meditation, humbled under a sense of undeserved mercies; and, while he clings to them more closely than ever, resolves, in the Divine strength, to spare neither time nor exertion to diffuse them among his famishing brethren, that the sons of Adam, in every land, may rejoice at the coming of the day of rest, and may attain to the animating, the imperishable hope of 'rest from their labours,' in 'the city that has no need of the sun nor of the moon to enlighten it.' M. L. D.

ELEVENTH WEEK—MONDAY.

THE CORN-PLANTS.—BARLEY.

Barley is, next to wheat, the most important, in a general point of view, of all the cereal grains which are cultivated in temperate climates, though, as far as relates to this country, it may be considered rather as a luxury than a necessary of life, being chiefly used for the purpose of producing fermented liquors. It is, in one respect, indeed, more useful than wheat. It may be propagated over a wider range of climate, bearing heat and drought more patiently, growing on lighter soils, and coming so quickly to maturity, that the short northern summers, which do not admit of the ripening of wheat, are yet of long enough duration for the perfection of this plant. It is the latest sown, and the earliest reaped, of all the summer grains. In warm countries, such as Spain, the farmers can gather two harvests of barley within the year,—one in the spring, from winter-sown grain, and the other in autumn, from that sown in summer.

Barley sown in June, is commonly ready for the sickle in three months after the seed has been committed to the ground; and, in very northern climates, the period necessary for its growth, as we remarked in a former paper, is of still shorter duration. Linnæus relates, in his tour in Lulean Lapland, that, on 28th July, he observed the commencement of the

barley harvest, and, although the seed had been sown only a few days before midsummer, that the grain was perfectly ripe, the whole process having thus occupied certainly not longer than six weeks.

The property of requiring little moisture, as well as of rapid growth, admirably fits barley for propagation in those northern countries, where the duration of summer is limited to a very few months in the year, and where wet is of very rare occurrence, from the time when the spring rains are over, at the end of May, or beginning of June, until the autumnal equinox, previous to which the harvest is reaped.

So hurtful is excessive moisture to the barley plants, that even heavy dews, if of frequent occurrence, are said to be injurious. Much wet is detrimental at all periods; but the mischief is exhibited in a very different manner, according as it occurs before or after the formation of the ear: If it happen during the former stage, the leaves will become yellow and sickly, and the ears will perhaps not make their appearance; whereas, if the ears have already been formed and completely filled, the grain, when visited by long continued falls of rain, will sprout; and, should the weather which follows be warm and genial, this growth will be so rapid, that the ears will put on the appearance of tufts of grass. Gentle showers, however, if of short continuance, and if they do not happen either very early after the plant is above ground, or during the time of blooming, or when the ear is full, are beneficial.

In its composition, barley differs materially from wheat; it contains more starch, far less gluten, and about seven parts in a hundred of saccharine matter, ready formed, which latter constituent wheat does not possess previous to germination.

Botanical writers enumerate four distinct species of barley; of these there are many varieties, produced by differences of soil, climate, and culture. Spring barley is the kind most commonly cultivated in Britain. In the more northern countries, and in the north of Scotland, square barley or bear, called also big, is in particular districts raised in preference, this being a much more hardy, though a coarser plant. The number of grains in

each ear is greater than is found on spring barley, in the proportion of three to two,—one ear frequently yielding forty or more grains. These are disposed in six rows. The other two varieties are the long-eared and the sprat-barley. Of the former it may be stated, that it possesses some peculiar good qualities, the husk being thin, and its capacity for malting being much esteemed;—of the latter, that the ears are broader than those of the others, and the straw so much shorter and coarser, as to render it not desirable for fodder. Besides these there is a variety lately introduced, called Chevalier barley, from the name of the agriculturist who has paid particular attention to its cultivation, which, though somewhat later than the common barley, has some excellent qualities, likely to recommend it to general culture.

The use of barley in the preparation of a fermented liquor dates from the very remotest times. The invention of this preparation is ascribed to the Egyptians by ancient Greek writers. Herodotus, in particular, expressly states, that the people of Egypt, being without vines, made their wines from barley.* This liquor is called *Zythum* by Pliny, but whether it was ale or ardent spirits, does not seem to be certainly known. An intoxicating liquid is still made from barley, both in Egypt and Nubia, to which the natives give the name of *bouzah*,—a word from which the English term to *bouse* is probably derived, through the medium of the Dutch. From a passage in Tacitus, it appears that the Germans were in his day acquainted with the art of preparing beer from malted grain; and Pliny describes a similar liquor under the name of *Cirevisia*. It further appears, that malt liquor has formed an article of manufacture and consumption in this country, from a period at least coeval with the time of Tacitus. It was not, however, till a comparatively modern date, that hops were used in the composition of ale.†

Of barley, there are above thirty millions of bushels con-

* Lib. ii. cap. 78.

† Henry VIII. forbade brewers to put hops and sulphur into ale; but, in the fifth year of Edward VI., privileges were granted to hop grounds.

verted into malt in Great Britain, and more than eight million barrels of beer, of which four-fifths are strong beer, are brewed annually.

That the process of fermentation is one of the powers of Nature, intended by Heaven for the benefit of the human race, cannot reasonably be doubted ; and that, when used with discretion, it has largely contributed to increase their comfort, and add to their medicinal resources, is equally true ; but such is the unhappy tendency of our fallen nature to abuse the gifts of the Creator, that, were the balance fairly struck between the practical advantages and evils of this provision, as they have hitherto been exhibited in society, I have no hesitation in saying, that it would be found to have proved a curse instead of a blessing.* This, however, is nothing more than may be stated of many other beneficent provisions of Providence, and affords only another proof of the abuse of our mental liberty, of the degradation of our nature, and of the state of discipline in which we have been consequently placed. Speaking of the moral world, we are told in the Divine Record, that 'God made man upright, but he has found out for himself many inventions;' and it is not less true of the physical world, that all the gifts of the Creator are in themselves excellent, but man has too often perverted and abused them to his ruin.

* This abuse has a tendency to correct itself. In America, where the vice of drunkenness was carried to a greater excess than perhaps in any other quarter of the civilized world, Temperance Societies have arisen, occasioned by a re-action, and the influence of Christian principle. There are in that country upwards of a thousand of these societies in operation, consisting of 100,000 members. The practical good effected by these institutions, is beyond all praise. Into Britain, also, they have lately been introduced; but they have not yet received the public support which their importance deserves.

ELEVENTH WEEK—TUESDAY.

THE CORN-PLANTS.—OATS.

The native place of oats is supposed to have been in a more northern climate than that of the other cereal plants, since it cannot be cultivated to advantage in the lower latitudes of the temperate zone. In the south of England, even at high elevations, the produce is inferior in quality to that which is obtained in districts nearer the polar circle.

This grain is extremely serviceable to man, possessing the advantage of growing upon soils, and in situations, where neither barley nor wheat can be raised. It is the hardiest of all the cereal grains cultivated in Great Britain.

In its outward structure, the oat plant differs from wheat and barley in the form of the ear. This, in oats, is not a spike,* with a single rachis, but a panicle,† containing a stalk and branches. While young and light, these branches arrange themselves round the centre of the stem; but, as they advance towards maturity, and acquire weight, they generally bend over on one side. By this arrangement, the air and light are enabled to visit, and the rain to wash, each individual grain, so that any lodgement of the larvæ of insects on the seeds, or of parasitical plants, is rendered difficult. The grains being pendent, and having the open extremity of the chaff towards the earth, are effectually defended from the lodgement of rain within,—an advantage which does not belong to the growth of wheat or barley, and these latter grains are consequently liable to diseases, especially in rainy climates, from which oats are exempted. Drought and heat, on the other hand, are unfavourable to this grain, which, under such

* Spike, in botany, is so called, where many flowers or seeds sit on a simple filiform flower-stalk, as in wheat and barley.

† Panicle is the name given, where many simple flowers or seeds stand on unequal branches, and a long flower-stalk

circumstances, become husky, containing but little farinaceous matter, and that being of inferior quality.

There are several varieties of oats, commonly cultivated in this country. Of these, the most remarkable are the black or long-bearded, the white, the red, the naked, the Highland early, the Churches, and the potato oat. The last mentioned is generally esteemed the most valuable, though of late years it has shown a tendency to degenerate. Of this kind, the first plants were discovered growing accidentally on a heap of manure, in company with several potato-plants; and it is to this circumstance that the distinctive name of the variety is owing. To an occurrence thus accidental, we are indebted for a kind of this useful grain, which, for nearly half a century, has been considered as the most profitable in existence. It requires to be sown on land in a good state of cultivation; when the grains will be found large, plump, and firm. The straw of the potato-oat is also of excellent quality. It is the variety most generally cultivated in the north of England, and in the lower districts of Scotland.

The seed time of oats is almost universally in March and April. The grain is scattered broadcast, in the large proportion of from four to six bushels to the acre,—the medium produce of which is from forty to fifty bushels.

The nutritive quality of oats is less, in a given weight, than that of any other of the cereal grains. In oats of the best quality, it does not exceed 75 per cent.; while that of wheat is 95½ per cent. The very small proportion of saccharine matter ready formed in oats, renders it both difficult and unprofitable to convert this grain into malt. Brewers at the present day, therefore, do not employ oats in the preparation of any kind of beer. In former times, when the public taste was different from what it is at present, a drink called *mum* was manufactured for sale, and in the preparation of this liquid, oatmeal was employed.

There is a kind of weed, called the wild oat, indigenous to this country, which, though it resembles the cultivated species in form, differs from it altogether in its qualities. Its

seed is exceedingly tenacious of life, and will remain buried under the soil for a century or more, without losing its vegetating power. Such a property in seeds, as I observed in the Winter volume, is very far from being uncommon.

Before leaving the subject of the corn-plants cultivated in our own latitudes, let us reflect for a moment on this bountiful provision of Creative wisdom. In a grain of corn, at one end of a groove, is a small protuberance, which is the germ or embryo of the future plant. This organ has been appropriately called *corculum*, or little heart. It contains within itself a principle, which, by being placed in the earth, and subjected to the influence of the seasons, evolves first a sprout, then a stalk with leaves and joints, and then, on the top of all, exposed in the most favourable manner to the action of the sun and air, a number of seeds, the whole of which productions, both in their early and mature state, are fit for the food of useful quadrupeds, while the seeds contain a farina admirably adapted for the nutriment of the human species.

Look, again, at the manner in which this important gift is propagated. It produces not only a plant, with its farinaceous seed; but, yielding a ready return to human industry and skill, it affords plants after plants, and seeds after seeds, in such abundance, that, in the course of a few harvests, the progeny of a single little germ might be rendered capable of feeding a nation. 'Thus it is,' says the author of the articles on Vegetable Substances, in the Library of Entertaining Knowledge, 'that in the lapse of ages, amidst the desolations of rude conquerors, and the alternations which the finest portions of the earth have endured, from civilization to semi-barbarism, the vital principle of vegetable life, destined for the chief support of the human race, has not been lost; and it has remained to man, like fire, which he alone has subjected to his use, to be called forth at his bidding to administer to his support, his comfort, and his advancement, in every art of social existence.'*

* Vegetable Substances, p. 40.

There is something very striking in the fact, that while conquest carries extermination over the face of the earth, it is also one of the frequent means employed by Providence for diffusing the blessing of useful plants among rude nations, as well as various other comforts of civilized society. Connected with this subject, it is exceedingly affecting to think that the value of decaying organized substances, as manure, may perhaps first have been taught to a savage people, by observing the effects produced by this process on a field of battle. This idea has been suggested by the following observations of an amiable and talented traveller, on the field of Waterloo. 'As I looked over this field, now green with growing corn, I could mark with my eye spots where the most desperate carnage had been, pointed out by the verdure of the wheat. This touching memorial, which endures when the thousand groans have expired, and when the stain of human blood has faded from the ground, still seems to cry to heaven that there is awful guilt somewhere, and a terrific reckoning for those who had caused destruction which the earth would not conceal. These hillocks of superabundant vegetation, as the wind rustled through the corn, seemed the most affecting monuments which Nature could devise, and gave a melancholy animation to the plain of death.'*

ELEVENTH WEEK—WEDNESDAY.

THE CORN-PLANTS.—RICE, MAIZE, AND MILLET.

In approaching the tropical regions, all the kinds of grain already treated of gradually disappear, and rice, maize, and millet, are cultivated in their place. These plants are obviously formed for occupying, with wholesome food, each in its own peculiar region, the extensive plains and rising grounds of the equatorial portions of the globe,—the rice affecting the low swampy lands on the banks of the rivers and streams,—the

* 'Essays Descriptive and Moral, by an American.'

maize also requiring moisture, but in a much smaller proportion,—and the millet being an inhabitant of light sandy soils, exposed, without mitigation, to the scorching rays of the sun.

Of rice itself, indeed, there are varieties, which almost render it fit for any state of moisture. The *common* and the *early* rice are both marsh plants, but the *mountain* rice thrives on the slopes of hills and in other situations where it can receive humidity only occasionally, and the *clammy* rice appears to be endowed with the peculiar property of growing both on wet and on dry grounds. The species chiefly cultivated, however, requires much moisture; and in almost all parts of the world where it is raised, the practice of irrigation has been adopted.

Rice is a panicled grass. The seed grows on separate footstalks, springing from the stem. Each grain is terminated by an awn or beard, and enclosed in a rough yellow husk, the whole forming a spiked panicle. The stalk is not unlike that of wheat, but the joints are more numerous.

The farina of rice is almost entirely composed of starch, having little or no gluten, and being without any ready formed saccharine matter. On account of this difference of composition, it is believed to be much less nutritious than the corn-plants already described.

There is little reason for doubting that this grain is of Asiatic origin. From the earliest records, it has formed the principal, if not almost the only food of the great mass of the population on the continent and in the islands of India, as well as throughout the Chinese empire. The introduction of it into America, where it is now so extensively cultivated, is of recent date. It is said, that about the end of the century before last, a brigantine from the island of Madagascar happened to put in at Carolina, having a little seed rice, which the captain gave to a gentleman of the name of Woodward. This he sowed; and as it was productive, it soon became dispersed over the province. It is reported also, that Mr. Dubois, Treasurer of the East India Company, about the same time, sent a small bag of rice-seed to that country; and from

these two parcels, it is supposed, that the two kinds, the red and the white, now raised in America, took their rise.

The swamps of South Carolina, both those which are occasioned by the periodical visitings of the tides, and those which are caused by the inland floodings of the rivers, are found to be well suited to the production of rice; and not only is the cultivation accomplished with little labour, but the grain proves of a remarkably fine quality. It is, in that part of the American States, extensively cultivated for exportation.

In some parts of Europe, and, in particular, on the rich meadows of Lombardy, which can be irrigated by the waters of the Po, and in the Province of Valencia, in Spain, where there are similar facilities, rice is successfully cultivated; but the effects of the flooding is found in Lombardy to be so detrimental to health, that the government has thought it necessary to restrict this profitable species of agriculture within certain limits.

Although rice be exceedingly prolific, it has been remarked, that it has a tendency rather to condemn the great body of the inhabitants to poverty, than to prove a source of riches, in those countries where it forms the sole article of food. The reason for this it is not difficult to discover. The people obtaining the bare means of subsistence, without laborious exertion, are destitute of those incentives to industry which so powerfully and so beneficially actuate the lower classes of the community in such countries as our own, and which infuse such life and vigour into all the various grades of society. Their native indolence restrains their activity; and in ordinary years, luxuriating in abundance, they are contented with the present, and form no schemes for the future. It is remarkable, however, that in such countries visitations of famine are both more common and more destructive than in those regions of the globe which are naturally less prolific. This is owing not merely to the want of provident habits in the inhabitants, but also to the circumstance of their entire dependance on one article of food. When a failure in their rice

crop occurs, they have no other kind of sustenance to fall back upon. The misery of their condition in this respect may be readily understood, by supposing what would be the state of our own poor if they depended solely for support on potatoes. That crop, from whatever cause, has showed for several years a tendency to failure in its prolific powers. It is frightful to think of the misery which must have ensued, had not a mitigation of the evil been found in the comparative abundance of the various kinds of grain, in which the labouring classes are enabled to find a substitute. In considering this subject, we shall find a confirmation of the reasoning contained in previous papers, as to the wisdom and beneficence of that providential arrangement, which has made hard labour, in by far the greatest variety of cases, essential as the means of procuring the common necessaries of life.

On the other kinds of grain which a beneficent Creator has granted to the inhabitants of the warmer regions of the earth, it does not seem necessary to say much. The plant of Indian corn or maize, consists of a strong, reedy, jointed stalk, provided with large flag-like leaves, and surmounted with hard seeds, growing round a cylindrical pith or *cobb*, and enveloped in a husk. It is said to contain no gluten, and little, if any saccharine matter, whence it has been asserted to have but small nutritive power. This theoretical conclusion is, however, contradicted by experience, as domestic animals, of every description, when fed on it, speedily become fat, their flesh being at the same time remarkably firm; and the common people of countries where this grain forms the ordinary food, are for the most part strong and hardy races. The produce of maize, on a given extent of cultivation, is greater than that of any other grain; and the proportional return for a given quantity of seed is equally advantageous. Perhaps it might be usefully introduced into this country as a green crop; but the experiments which have been made, notwithstanding the strong assertions of Mr. Cobbett to the contrary, seem to prove, that in our climate the seeds do not, in ordinary years, come to maturity.

Millet, the smallest of all the cereal seeds cultivated for food, grows on arid soils, where rice and maize cannot be successfully cultivated, and forms the chief subsistence of the people in some parts of India, through the sandy districts of Arabia, in Syria, where it has been produced from the earliest periods, and in Nubia, where the inhabitants cultivate this almost to the exclusion of every other species of grain.

A hardy variety of this plant is also grown in Germany, and was introduced into Switzerland by M. Tschiffeli, about the middle of last century. This gentleman has published an account of his method of cultivation, in the Transactions of the Berne Society, in which he strongly recommends it to the attention of agriculturists. Among the advantages which it offers, are stated, its adaptation to all sorts of soils, the small quantity of manure which it requires, the trifling amount of labour for which it calls, and the small degree of exhaustion which it occasions to the soil, in comparison to the largeness of the return which it yields. These are great recommendations; but it is believed, that, in Britain, the climate is not sufficiently warm and dry for ripening the seeds.

ELEVENTH WEEK—THURSDAY.

LEGUMINOUS PLANTS.—PEAS AND BEANS.

Pulse, or the legumes, are a numerous class of vegetable productions, widely diffused over the globe, several of which were very early made articles of cultivation. Of these the pea and the bean, which are in most common use, shall form the subject of a short notice in this paper.

The whole of the edible legumes, with the exception of some of the species which grow on trees, have their flowers papilionaceous, or, in shape, resembling butterflies. The seeds are contained in an oblong pod, consisting of two valves, on the upper suture of which they are placed alternately on

each side. These seeds, in germinating, push forth only one stem, so that they do not tiller, like the corn-plants, but the buds on the stem produce fertile branches. All the kinds afford much less nutritive matter than the *cerealia*.

Peas contain fifty-seven and a half per cent. of nutritive matter, a proportion of which is saccharine. Beans have very nearly as much nutriment, but it is not entirely composed of the same principles. No saccharine matter, ready formed, is found in this vegetable, which is considered coarse, but nutritive.

The pea is a climbing plant, furnished with tendrils at the terminations of the compound leaves. The varieties are very numerous. Of the common pea, the principal varieties are the white or yellow, and the grey. The sub-varieties are never ending. Of these, no fewer than twenty-two have been enumerated as objects of garden culture, differing in the colour of the flowers, the height of the stalk, the time of coming to maturity, the produce of the pods, or the size or flavour of the seeds. There is a difference, also, in the degrees of tenderness and hardihood, which fit them for different exposures, and in the richness or poverty of the soil they demand, which requires a variety in the mode of cultivation. All these circumstances, which have been probably produced by various modes of treatment, are calculated to exercise the skill of the cultivator, and to afford a stimulus to his discriminating industry.

The native country of the common pea is not known, as it was a cultivated vegetable before the commencement of botanical history. It is probable, however, that it was introduced into Britain from the warmer parts of Europe, and may have been brought to these from Egypt and Syria. It is known in India, China, and Cochin China, but it is not very plentiful in those places, and there is no evidence of its being a native plant. It is more abundant in the Japan Isles, the climate and soil of which appear to agree better with its habits. It seems equally to droop under the extremes of heat and cold; and we may therefore conclude, that it has taken

its origin in some of the warmer latitudes of the temperate zone.

Historical evidence would make it appear that both the pea and the bean must not only have been introduced, but must have been extensively cultivated, in some parts of Scotland, as well as in England, at a very early period. It is on record, that when the English forces were besieging a castle in Lothian, in the year 1299, their supply of provisions was exhausted, and their only resource was in the peas and beans of the surrounding fields. This circumstance seems to lead to the belief, that these plants were then raised extensively as articles of common food. Fuller, however, mentions that peas were brought from Holland, in the time of Queen Elizabeth, which were 'fit dainties for ladies, they came so far, and cost so dear;'—this must allude to some more delicate kinds which had not even at that comparatively late period been introduced into the British gardens.

Peas are at present annually cultivated to a great extent in Britain, though their use has been considerably circumscribed by the introduction of potatoes. They are consumed in immense quantities as sea provisions; they are in familiar use in families; and they furnish a valuable food for horses.

The bean is supposed to have been introduced into this country by the Romans. The Greeks were of opinion that its native country was Egypt, perhaps because they received it for cultivation from that country. Some travellers assure us that the bean is found growing wild in Persia, near the shores of the Caspian Sea; but that part of Asia has been subjected to so many fluctuations, so many alternations of culture and destruction, that it is not easy to decide how far any plants, which may there be discovered vegetating spontaneously, are really indigenous, or only the remains of a former cultivation.

Beans are cultivated over many countries, as far to the eastward as China and Japan; and in many parts of Africa they are extensively used as an esculent. From the northern coast of this continent, some of the most valuable varieties

were transplanted by the Moors into Spain, and by the Portuguese into their own country.

The bean is only used in this country for culinary purposes in a green state; when mature and dried, it is considered as a useful food for horses. King stated the annual consumption in this country, about the middle of last century, to be of beans four millions of bushels, and of peas seven millions. This is a large consumption for that period; but the accuracy of the statement has been doubted, though, certainly, a very considerable exportation of horse beans was at that time made, for the use of the negroes in our plantations.

All the cultivated beans are annuals, having upright fibrous stems, rising from two to four feet high. The flowers are usually white, with a black spot in the middle of the wing. These are succeeded by long thick pods, woolly within, and enclosing flat seeds. The flowers are very fragrant, and the rich perfume of a bean-field, when the plants are in full blossom, is as familiar as it is delightful to all lovers of simple rural pleasures.

There is another species of this plant, called the kidney-bean, some varieties of which are found in cultivation throughout almost every civilized country of the western, as well as the eastern, hemisphere. In England only the immature pod is used for food; but in France, the ripe seeds known by the name of *haricots*, are prepared in various ways as a favourite edible. A variety of this bean, called *fricolli*, is in general demand all over Mexico.

The stems of the kidney-bean, are, in all the varieties, more or less voluble, and contrary to the ordinary law of Nature, instead of turning in the direction of the sun, turn in a contrary direction. To account for this, it has been supposed that the native place of this plant is on the southern side of the equator, and that the plant, though through so many generations removed to the north, 'is still obedient to the course originally assigned to it, turning in a direction which, in its native climate, would be towards the sun.'* Should this

* Loudon's Encyclopedia of Gardening, p. 694.

prove to be the case, which the analogy of nature renders very probable, it furnishes a remarkable confirmation of a fact supported by many proofs, that the Creator has impressed, not merely a certain constitution, but certain habits on plants, corresponding to the localities in which they were intended to grow, originally independent of external stimuli, and sometimes, as in the present instance, unaffectable by them.

ELEVENTH WEEK—FRIDAY.

ESCULENT ROOTS.—THE POTATO.

THERE is a great variety of roots and tubers, fit for the use of man and domestic animals, several of which are extensively cultivated, such as turnips, onions, carrots, parsnips, and beets. The most remarkable, however, and useful of them all, is the potato, to which, on this branch of our subject, I shall at present confine my attention.

The same mystery which hangs over the native place of most of the other plants, made use of by man as objects of cultivation, long attached also to the potato; but it appears now to be satisfactorily proved, that it is indigenous in the west coast of South America. In Chili and Peru it is found growing wild among the rocks, in remote places, where it is not probable that the seed could have been carried by the hand of man; and what seems to confirm the idea that it is there in its uncultivated state, is, that the flowers are always pure white, without any of those diversities of colour, which, in conformity to a well-known law of Nature, exist in the cultivated varieties.*

The potato plant seems first to have been introduced into Britain by Sir Walter Raleigh, in the reign of Queen Elizabeth; but, for more than a century, its progress was exceed-

* Account by Mr. Cruickshank, published in Dr. Hooker's 'Botanical Miscellany,' and quoted in the 'Journal of the Royal Institution,' for December, 1831.

ingly confined, owing probably to erroneous modes of cultivation, and to an improper manner of preparing it for food. In the reign of James I, this root was considered a great rarity, and sold so dear as two shillings per pound; and even as late as the beginning of last century it seems not to have entered into the list of agricultural produce. Bradley, who wrote about the year 1720, and who treated expressly of new improvements in horticulture, says of potatoes, 'They are of less note than horse-radish, radish, scorzonera, beets, and skerrit; but as they are not without their admirers, I will not pass them by in silence.'

The district of England, where the potato was first generally cultivated, seems to have been Lancashire; and, about the same time, it was introduced to general use in Scotland. In 1728, a day-labourer of the name of Prentice, living near Kilsyth, in Stirlingshire, successfully raised a crop of potatoes, on a little plot of ground attached to his cottage, and was fortunate enough to call the attention of his neighbours to the value of this hitherto neglected vegetable. By the annual sale of his produce, he soon realized what was to him a fortune, the sum of £200; and, meanwhile, the public attention being called to the plant, it gradually made its way. It was not, however, till after the year 1743, which was remarkable as a season of scarcity, that it came to be generally cultivated in Scotland as a regular branch of field husbandry. I very well remember a near relative of mine mentioning an anecdote, which showed that, so late as the year 1755, or 1756, the potato was still little known in Wigtonshire.*

In England, with the exception of Lancashire, the progress of this esculent into general cultivation was still slower. It was known in Yorkshire only as a garden plant, down to 1760; and, in Somersetshire, we must date its introduction,

* This incident was, that a lady had brought some potatoes in her pocket to church on Sunday, to present to a friend, as a rarity; but the string of her pocket breaking as she was in the act of going out on the dismissal of the congregation, she lost her burden in the passage, which created considerable amusement.

as an article of farm produce, at least ten years later. After this period, however, the value of the potato came to be very generally appreciated; and, in the year 1796, in the county of Essex alone, no fewer than 1700 acres were planted with this root, for the supply of the London Market.

Potatoes seem to have found their way into the Continent of Europe, at a considerably later period than into England; but they came more rapidly into common use, and we may date their general cultivation there from about the middle of last century.

This root, when first introduced as an article of husbandry, was acknowledged to possess more vigorous powers of reproduction than almost any other vegetable. In the potato itself are comprised the germs of numerous plants, which are situated in indentations called eyes; and the usual mode of propagating the plant has been by cutting the tuber into several sections, or sets, each containing one or more eyes. In this way good varieties are extended and preserved when once obtained.

The proper seed, however, is contained in the apple, a large green berry, which succeeds the flower. In this apple are found numerous white seeds, which, when sown, produce, like similar seeds, numerous varieties of the plant;* but the tubers obtained from the seeds are at first very few and small, and

* The Rohan potato, a variety raised on the Continent a few years ago from the seed, is remarkable for the size of its stalks, and its prolific powers. Prince Charles de Rohan, from whom it takes its name, writing of it from Geneva, in 1834, states, that the stalks reach six or seven feet in height, and require to be supported on transverse stakes; and that the tubers sometimes increase to such enormous size, that a single potato will weigh more than 13lbs; and, as to the quantity of produce, he mentions the following example:—'The attorney of the Abbey of Auterive, Canton of Fribourg, to whom I had given two tubers, two years ago, and who, delighted with his first harvest, after having eaten, and given some to his friends, planted the rest, obtained last autumn, *six double-horse loads, and eight scuttle-fulls.*' Le Cultivateur, Journal de Progress Agricolis, January 1835, quoted in the Journal of Agriculture, vol. vi. p. 145. The Author has cultivated the Rohan potato for the last two years, but he doubts if, in this climate, it will prove profitable for general cultivation.

it is not till the third year that these tubers come into full bearing, a circumstance which renders it unprofitable to the farmer to propagate the potato in this way.

It appears, however, from experience, that when potatoes are raised in the usual way, they gradually lose their vegetative energy, and become liable to diseases, and injurious influences, which, in their more vigorous state, they were able to resist. A tendency in the plant to degenerate, under the present mode of culture, has long been observed, and some farmers have been careful to renew it at intervals, by having recourse to propagation from the seed. But this useful practice has not been so generally attended to as it ought to have been; and, at the present time (1837), in consequence of this neglect, much distress is occasioned among the lower classes, in various districts, by the failure of the crops. The history of the propagating power of the tuber seems to be as follows:—At the third reproduction from a tuber, produced by a seed, the reproductive power, as has already been stated, is in full activity. Then the produce is greatest; but the potato being, at this stage, in general watery, and what is called waxy, is not esteemed very palatable for food. In a few years, however, by constantly reproducing from the tuber, the potatoes become less productive, but more dry and mealy. This progress goes on, year after year, the roots always improving in quality, but diminishing in quantity, till, at length, it should seem that the vigour of the living principle, by this mode of treatment, wears out, and the plant first becomes subject to disease, and alive to all unfavourable influences of soil and weather, and finally ceases to reproduce.

This subject has not hitherto been attended to by scientific, or even practical men, as it deserves. A crisis in the history of this valuable esculent seems, however, at last to have arrived, which must force the subject on public observation. The *curl*, a well-known disease, first alarmed cultivators. It began in Lancashire, where the potato was early cultivated, and soon spread over all the richest districts of the country. This seems to have been the earliest indication of decay in

the reproductive powers, and the precursor of that more general failure with which the community is threatened. What would be the consequence of the extermination of a crop on which has depended so much of the comfort of the poor, and to the introduction of which so much of the rapid increase of our population during the last century may be traced, it is dreadful to contemplate.

The whole subject, indeed, connected with the history of the potato plant, is full of varied interest. The religious mind, especially, will find cause for deep reflection on the ways of Him, whose providence acts always with such consummate wisdom, but frequently so mysteriously. By the discovery of this additional means of aliment, so salubrious, so plentiful, and so cheaply propagated, at a time when manufactures and the arts were, from other causes, in such rapid progress, it seems to have been the intention of Providence that society should receive an additional impulse, and that the population, constantly pressing against the means of subsistence, should obtain a temporary relief. But this, it is obvious, could only be available to a certain point; and, like every other improvement in the quantity and quality of food, has a tendency, by increasing the stimulus of human reproduction, to defeat itself. Whether or not the check, which appears at present to be in progress, shall be arrested by the application of human skill, or in what way it may operate, in promoting the moral welfare of civilized society, it is impossible to predict. But it cannot be doubted, that, like every other appointment of the Supreme Ruler, it will terminate in some important and useful result. It is the high privilege of the Christian to be assured that evil as well as good are in the hands of Him who 'doth all things well.'

ELEVENTH WEEK—SATURDAY.

VEGETABLE SUBSTANCES USED FOR WEAVING.—THE FLAX-PLANT.

VEGETABLES for food are of primary importance, but there are other uses to which various kinds of plants have been applied, and for which the Creator seems to have intended them. Among these the plants employed as materials for the production of woven fabrics, and twisted cords, deserve the first mention.

Flax is the vegetable which appears to have earliest attracted the attention of mankind, for the useful qualities of its fibres. We learn from the sacred record, that even so far back as the time of Joseph, men had exerted their ingenuity in the manufacture of this substance into cloth. The first mark of favour to that remarkable man, by the Egyptian king, was, among other things, to array him in vestures of fine linen. After this period, linen is constantly and familiarly mentioned in the Israelitish history, the fineness of the fabric being frequently alluded to. If it be doubted whether or not the flax which we now cultivate was the substance employed in this manufacture, all reasonable ground of doubt will be removed, by the accounts given of the linen cloths found in the unwrapping of Egyptian mummies of the highest antiquity. What is particularly worthy of remark is the fineness of the manufacture of these ancient cloths, indicating, what indeed we might have expected from the Scriptural notices, though otherwise scarcely to have been looked for, that, in this period of remote antiquity, the Egyptians, and perhaps some other nations, had advanced to a high degree of perfection in that art. Captains Irby and Mangles, speaking of the cloth found wrapped round the bodies of some mummies taken from pits at Gournou, on the site of ancient Thebes, say, 'Some of this linen is of a texture remarkably fine, far surpassing what is made in Egypt at this day, and proving that their ancient

manufactures must have arrived at a great degree of excellence.' If we were to suppose that Joseph's vestments bore any approach to these fabrics, it would be curious to speculate on a state of society which could so soon demand and reward the exercise of such ingenuity, while the other inhabitants of the world were little advanced beyond the simplicity of wandering shepherd tribes. At all events, the use of flax, as an article of manufacture, in so early a stage in the history of the world, is a fact of importance.

The hardy nature of the flax plant is a beneficent provision of Providence, which we must not omit to mention. 'There is scarcely any plant,' says the writer whom I at present chiefly follow, 'which is found to be so little affected by difference of soil and climate as the flax plant; and, accordingly, one species, with all its characteristics unaltered, flourishes in the cold as well as the temperate regions of Europe, in North and South America, in Africa, and in Asia.' 'This plant will grow on almost any land, but it impoverishes the soil, and therefore it is deemed prudent to sow it on rich rank ground, and never two years consecutively on the same spot.'

The common flax is an annual plant, which shoots forth in slender upright stalks, about the thickness of a crow-quill. The stalks are hollow pipes, surrounded by a fibrous bark or rind, the filaments of which, divested of all extraneous matter, and carefully prepared, are the material of cambric, linen, and other similar manufactures. The leaves placed alternately on the stem, are long, narrow, and of a greyish colour. When the plant has attained the height of about two and a half or three feet, the stem then divides itself into slender foot stalks, which are terminated by small blue indented flowers. These produce large globular seed-vessels, divided within into two cells, each containing a bright slippery elongated seed.

Although flax is easy of growth, its quality depends very much on fitness of soil and situation. Low grounds, and those which have received deposits left by the occasional overflowing of rivers, or where water is found not far from the surface, are deemed the most favourable situations for its cul-

ture. It is attributed to this last circumstance, that Zealand produces the finest flax grown in Holland. The alluvial soil of Egypt may, in like manner, account for the early and successful cultivation of the plant in that country. In the Crimea, too, and in the Russian territories near the Black Sea, on the rivers Dniester, Bog, Don, Dnieper, and in Kirban, where the soil is at once moist and rich, the flax is of a peculiarly excellent quality.

Preparatory to the cultivation of this plant, it is not necesary that the ground should be very deeply furrowed by the plough; but it should be reduced to a fine friable mould by the repeated use of the harrow. Two or three bushels of seed are required for each acre of ground, if scattered broadcast; but half the quantity will yield the same produce, if sown in drills. When flax is raised to be manufactured into cambric and fine lawns, double the quantity of seed is sown on the same space of ground,—the plants, growing nearer to each other, have a greater tendency to shoot up in long slender stalks; and as the same number of fibres are usually found in each plant, these will, of course, be finer in proportion as the stalks are slender.

The seed is usually sown in March and April. The plant blooms in the end of June, or beginning or middle of July, and is considered ripe, and fit for pulling, towards the latter end of August. It has been found by experience, that the seeds of flax, like those of most other plants, may be pulled without injury, and even with advantage, before they are quite ripe, provided they are not detached until dry, from the parent plant; and it has also been found, that the period which precedes maturity, when the stalks begin to turn yellow, but before the leaves fall, is the most advantageous time of removing them from the soil, for giving softness and strength to the fibre. The Dutch avail themselves of these facts, while they are either unknown or neglected, especially as relates to the seed, by their less intelligent and careful neighbours. After pulling the plants, they stack them. The seed, by this means, becomes ripe, while the fibres are collected at the most

favourable period of their growth, and both the valuable products of the plants are secured in their perfection.

It would be inconsistent with our plan to detail the various laborious processes by which the flax is prepared for manufacture; and I shall only add, that not only is the fibre of this valuable plant converted into cloth, but from its seed an oil is extracted, which is extensively used in the arts.

In this short account, the reader must have seen occasion, in various particulars, to admire the Creative intelligence and bounty, which has made a plant of such general utility so extensively available for cultivation. In the constitution of the flax plant, as of many others, two intentions of the Creator are particularly conspicuous,—the one is to bestow upon man a useful gift, and the other to call forth his inventive faculties, to stimulate his activity, and to reward his industry and skill.

TWELFTH WEEK—SUNDAY.

TRUE SCIENCE, THE HANDMAID OF RELIGION.

There are few mistakes less reasonable than that which leads believers to entertain a jealousy of the investigations of science, as if there were a risk that our holy faith might be undermined by the progress of philosophical discovery. Science, properly so called, is nothing else than the knowledge of truths. Scripture, rightly interpreted, is emphatically the word of truth; and, though the subjects treated of by each, may have no immediate relation to one another, still it is impossible that there should be any contradiction between them. Truth cannot be opposed to truth.

But it will be said that this reasoning is refuted by facts, since those who have entered most deeply into scientific investigations have been often tainted with infidelity. This, how-

ever, is an assertion to which we cannot subscribe. It is true that much which has been falsely termed philosophy, has been from time to time quoted in opposition to the authenticity of the Bible, and that many, who have been dignified with the title of scientific men, have lent to the same cause the credit of their names. But there was nothing approaching to infallibility in either; and, I need not say, that the invariable result of more patient research, and more mature consideration, has been to establish the Bible's divine authority more firmly and satisfactorily than ever.

The particular subjects upon which philosophy has been employed by infidel writers, to aid them in their attacks upon Scripture, are those upon which the sacred volume was never intended to afford us any specific information; such subjects, for example, as the structure of the earth and the planetary system. It has already been shown, that to look for a formal treatise on cosmogony or astronomy in a book intended to reveal the method of man's recovery to the favour of God, and to instruct him in his duties, would be altogether to mistake the nature and character of such a publication. Scripture, if it enter on these subjects at all, speaks not in the language of scientific truth, because it is not addressing philosophers, as such, but in the simple language of plain men, for whose use it was intended. And yet, in the first chapter of Genesis, and in various incidental notices scattered through its pages, we find enough said in this spirit, at once to bring Revelation to the test of *genuine science*, and to afford short-sighted, presumptuous, and shallow smatterers in 'science falsely so called,' not the shadow of an apology for subjecting it to their scepticism. This test has been applied,—this criticism has been exercised,—by persons of every variety of intellect, and temper, and disposition:—And what has been the result? It is instructive to glance at the history of this controversy from the first dawn of philosophy after the night of the dark ages. A gloomy superstition, only relieved here and there by the genuine piety of such men as Thomas A Kempis, brooded over Europe; and when a spirit of inquiry was

first evoked from the moral darkness of the world, the jealousy of religionists, who, in the excess of their bigotry, had been at no pains to inquire into the foundations of their faith, and knew not how strong are the pillars of the Christian temple, induced them to wage, against those who manifested any disposition to question the truth of ancient opinions, a war of unrelenting persecution. Although we may deeply lament that the name of religion should ever have been prostituted to such a service, and although we may well sympathize with the sufferings of such martyrs as Galileo, we have reason to rejoice that the spirit of investigation was not thus to be quenched.

It proceeded in its luminous way, till it gained the positio and the power which it deserved; and, in place of being looked on as the foe, became the handmaid and the friend of the faith of Jesus. During this process, however, if professed Christians were blameable for their folly in thus adhering to a system, and defending it with the weapons of a carnal policy, when they had not the moral courage to examine its authority, the disposition of many who assumed the air and the garb of philosophical inquirers, was as little to be admired. Pleased with their own fancied discoveries, or led away by an enthusiastic admiration of those of others, or perhaps, in many cases, glad of an excuse for casting off the restraints of religion, such individuals, during a long series of ages, were perpetually to be found thrusting forward the crudest speculations, which they dignified with the name of truths, and to which they demanded the unqualified assent of all who pretended to the character of scientific men. These notions often became fashionable for a season; and then Scripture must be brought to answer at their bar, and must be condemned or approved, only as it should be found to agree with this, for the time, infallible test of truth. Thus were religion and infant philosophy unnecessarily brought into collision, and the indubitable declarations of the former made to hold a subordinate place to the uncertain indications of the latter. Hence, till toward the close of the last century, nothing was more com-

mon than the malignant insinuations of an infidel spirit, or the open attacks of scepticism. These efforts were chiefly favoured by the imperfection of the sciences. A portion of the book of Nature had been opened, but so small a portion as to leave the full bearings of every subject to be guessed at, rather than known; while the vanity and recklessness of half-taught minds, attributed to their pretended discoveries all the authority of facts, and induced their adherents to exalt them infinitely above any opposite opinions, however long established,—nay, even to prefer them to the Bible itself.

Of the ease with which the human mind, when once disposed to give an undue preference to any fondly cherished views, may be induced to resist the most palpable demonstration of an opposite tendency, we have a remarkable example in the history of the blessed Redeemer. What philosophy was to the literati of the last century, the investigation of the Old Testament Scriptures appears to have been to the Rabbis and Scribes of our Saviour's era. Now, we are told,* that, shortly after the commencement of his ministry, Jesus went up to Jerusalem, and when he had given public testimony there to his divine character, in two ways,—first by the performance of a miracle, and then by the striking character of his preaching,—presently a discussion arose among the citizens, as to the weight of his pretensions. Some inclined to a belief, that so extraordinary a man could be no other than the Messiah; others attributed his powers to the influence of Satan; but there was a third class, who, in the very spirit of modern scepticism, produced their pretended knowledge of the law, as the infallible datum upon which the question was to be decided. 'We know whence this man is; but when Christ cometh, no man knoweth whence he is.' This argument, plausible as it might appear, had no good foundation. Its premises were entirely defective. No passage in the Old Testament makes any assertion such as that which is here pretended. Isaiah, indeed, asks the question, 'Who shall declare his generation?' and the Rabbis,

* John vii.

founding upon this, had formed the opinion, that the place of Christ's birth, and that of his parentage, should be a mystery; or perhaps they deduced this notion from the typical history of Melchizedek. But, from whatever source derived, and however plausible it might appear to them, ignorance was its author, and that very book on which they professed to found their opinion, in various passages, contradicted it. For what can be plainer than the language of Isaiah on this very subject,—'There shall come forth a Rod out of the stem of Jesse, and a Branch shall grow out of his roots?' or what more distinct than the words of Micah, 'Thou Bethlehem Ephratah, though thou be little among the thousands of Judah, yet out of thee shall he come forth unto me that is to be Ruler in Israel, whose goings forth have been from of old, from everlasting?' If, instead of holding to their unsupported theories, they had only been at the pains to turn their attention to such passages as these, and, not content with a part, had diligently compared the whole of the ancient Scriptures with the history of Jesus, they could not have resisted the assurance that verily he was the Son of God, the Messiah who was to come.

The application of this illustration may safely be left to my readers. Let us rejoice that the progress of genuine knowledge has greatly altered the relations that subsist between philosophy and religion. The frequent demonstration of the liability of the most learned to err, has taught wholesome lessons of modesty and caution. The more deeply Nature has been investigated, the closer the analogy has been manifested which exists between the work of creation and the work of grace revealed in the word of God. Proofs corroborative of the authenticity of the Bible, have been gathered from those very sources which formerly were applied to by the sceptic for his sharpest weapons; and at this moment (such is the security with which Christianity may regard the progress of knowledge), there does not exist in our own country, nor, so far as I am aware, in any other, one philosopher of eminence who has ventured to confront Christianity and philosophy as manifestly contradictory. May we not venture to hope that,

in a very short time, the weak darts of minor spirits, which from time to time are still permitted to assail our bulwarks, will be also quenched, and the glorious Gospel, set free from all the oppositions of science, falsely so called, shall walk hand in hand over the earth with a philosophy always growing in humility, because every day becoming more genuine.

G. J. C. D.

TWELFTH WEEK—MONDAY.

VEGETABLE SUBSTANCES USED FOR WEAVING.—THE COTTON-PLANT.

The cotton-plant, another vegetable substance, extensively used in manufactures, differs materially from that already described, in its properties, appearance, and habits. Instead of being generally diffused over temperate climates, it belongs more properly to the torrid zone, and the regions bordering on it; and, instead of being chiefly confined to one species, as to its peculiar and useful qualities, its varieties seem scarcely to have any limit, extending from an herb* of from eighteen to twenty inches in height, to a tree† far surpassing our largest oaks in elegance and magnitude. In one species it is annual, in another perennial. The nature of its fibre, the shape of its leaves, its flowers, and its fruit, all form points of contrast. It is in the pod of all the species that the substance is situated which forms this valuable article of manufacture. In one kind this pod contains only ten or twelve seeds; in another as many as thirty; while in all there is a marked difference in colour, shape, and size. In the quality and colour of the cotton itself, there is considerable variety. Some plants produce cotton of a dazzling whiteness, others of a yellowish brown, or a pale red colour, with many intermediate shades, —from that which serves as the material for the Chinese

* Gossypium herbaceum, or common herbaceous cotton-plant.

† Bombax ceiba, or African silk cotton-tree.

nankeen, to that which in the West Indies is known by the name of Siam, and is so noted for the snowy brilliancy of its hue, as well as the fineness of its long elastic fibres. Lastly, some kinds are much more productive than others, one yielding its downy harvest twice in the year, another only once,—one giving an abundant, another a scanty, return.

All this gives exercise to the ingenuity and intelligence of the cultivator. To him it becomes a matter of much interest to be made acquainted with all the distinctive varieties, some being so much more valuable than others. For want of this knowledge, so little regard is frequently paid to the selection of the seed and the improvement of the stock, that the careful planter, on first commencing his plantation, has to contend with many difficulties, and can only hope to succeed at the cost of much labour, and numerous disappointments; but then his industry promises, in the end, to produce an ample reward.

The cotton-plant will grow within a certain range of climate, in most situations and soils, and is cultivated with very little trouble or expense. According to Humboldt, the larger species, which attain to the magnitude of trees, require a mean annual temperature of 68° Fahrenheit; the shrubby kind may be cultivated with success under a mean temperature of 60° or 64°, and may be propagated as far as latitude 40°. This plant is indeed cultivated in the neighbourhood of Astracan, the latitude of which is 46°. Some species flourish best in the neighbourhood of the sea; others again require the interior. The Pernambuco cotton, which is the finest in Brazil, is of the latter kind; and the planters find, that in proportion as they recede from the coast, the quality of the cotton is improved; they are, in consequence, every year penetrating farther into the interior, and they always obtain a ready market for their produce, as the dealers follow their footsteps, and settle where they settle.*

When the season has been favourable, the cotton is gen-

* Kosler's Brazil.—Library of Entertaining Knowledge, on Vegetable Substances, p. 41.

erally fit for pulling about seven or eight months after it has been sown. This period is well indicated by the spontaneous bursting of the capsule or seed-pod. The plantations, at this time, present a very pleasing appearance, the glossy dark green leaves, finely contrasting with the white globular forms profusely scattered over the plant. In the East the produce is gathered by taking off the whole of the pod. In other parts, and this is the more general practice, the seeds and cotton only, are taken away, leaving the empty husks. The latter method is the most advantageous, though the most tedious; for when the outer part is removed, it breaks among the cotton, and it cannot be freed from it without much time and difficulty. Whichever method is pursued, the work is always performed in the morning, before sunrise, as soon as possible after the cotton displays itself, because long exposure to the sun injures its colour, by giving it a yellow tinge.

The celebrated Sir Richard Arkwright, then a poor barber, gave to British manufactures an extraordinary stimulus, by the invention of spinning machinery—one of the most astonishing and successful efforts of mechanical ingenuity. Since that period, the annual increase of our manufactures, and the consequent consumption of cotton, has been rapidly progressive. The present average value of cotton goods exported from Great Britain, amounts to the enormous sum of from thirteen to fifteen millions sterling for piece goods, and from three to four millions for yarn and twist.

The processes of spinning and weaving, as conducted by machinery, are truly astonishing; but I must not at present stop to describe them. The following fact, however, which I extract from the Library of Entertaining Knowledge, will serve to exemplify the celerity with which manufacturing operations are now conducted in this country. The proprietor of a cotton manufactory in Manchester, having recently received an order for the shipment of some goods of a particular description, purchased ten bales of cotton of suitable quality, in Liverpool. On their arrival in Manchester, they

were received into the highest floor of his works, and thence, proceeding regularly downwards, underwent all the intermediate processes of carding, spinning, and weaving, until, in ten days from their reception, the finished goods into which they were converted, were packed in bales, and were proceeding again to Liverpool for shipment.*

When, in 1787, spinning machinery was first erected, one pound of Demerara cotton could be spun into yarn one hundred and sixty miles in length.† Since that period, great improvements have been made in this kind of machinery; and yarn is now spun having a still greater degree of fineness.

There cannot, perhaps, be a more remarkable proof of the effect which the various providential arrangements of the material world produce, in stimulating the mental qualities, than in the invention of the machinery which possesses these amazing powers. The invention and perfecting of the steam-engine, with its tremendous forces, had only a little while preceded it; and this, too, received its stimulus from the wants of civilized man in another department. The mechanical genius of Arkwright took fire at this effort of a kindred mind; and, minutely observing the laborious, and sometimes imperfect processes, by which the produce of the cotton-plant was fitted to supply the necessities and comforts of men, he formed the apparently Utopian scheme, of applying this newly discovered force to the improvement and acceleration of these processes. The difficulties with which, under the most favourable circumstances, a poor and unfriended workman had to contend in this most arduous attempt, may be more easily supposed than described; and these difficulties seem to have been tenfold increased by domestic jars and want, consequent on the neglect of his proper employment. The time, however, was come, when the progress of society demanded, as it were, a genius adequate to the task. Arkwright persevered; and, by the dint of an energy of mind and a power of invention, with which few mortals have been favoured, produced a system of machinery, which, for the ingenuity of its contri-

* Article, Vegetable Substances, p. 49. † Macpherson.

vances, and the extent of its complicated arrangements, forms one of the noblest monuments to genius ever erected by human resources. And, what constituted his highest reward, he had the satisfaction to think, that by this one happy invention, he had bestowed a gift on his country, which was to be the means, in the hand of Providence, of averting, or, at least, indefinitely protracting the period of a national bankruptcy, on the verge of which Britain was labouring, of largely advancing its prosperity, and of giving vigour and permanency to its various powers.*

TWELFTH WEEK—TUESDAY.

VEGETABLE SUBSTANCES USED FOR CORDAGE.—HEMP.

The vast importance of commerce to the advancement of society, has rendered every thing which may promote its welfare a matter of research, especially in modern times. Among such objects, materials, which may contribute to safety or commodious use in shipping, hold a prominent place. In the early history of navigation, thongs of leather were usually, and, indeed, almost universally, employed for the purpose of naval cordage; and it was not till civilization had made considerable advances, that vegetable substances were generally substituted. There are several kinds of these substances, however, which have been found admirably adapted for this purpose; and, among these, hemp is that most commonly used.

This plant seems to be indigenous in Europe. We have, at least, proof, that it has grown, and been employed, in this quarter of the world, for between 2000 and 3000 years. Herodotus, the father of Grecian history, says, 'Hemp grows in the country of the Scythians, which, except in the thickness

* In 1762, Hume had predicted a national bankruptcy, should the national debt ever amount to a hundred millions. He founded his anticipations on reasoning, which only proved to be unsound, because he did not take into account the inventive genius of a Watt and an Arkwright.

and height of the stalk, very much resembles flax; in the qualities mentioned, however, the hemp is much superior. It grows in a natural state, and is also cultivated. The Thracians make clothing of it, very like linen cloth; nor could any person, without being very well acquainted with the substance, say whether this clothing is made of hemp or flax. A person who has never before seen hempen cloth, would certainly suppose, that this, of which I am speaking, is made of flax.'* This quotation seems to prove the coarseness of the cloth manufactured in the time of Herodotus. There could have been no difficulty in distinguishing between the cloth made from flax and from hemp, had the linen of those days borne any resemblance to that of modern times.

Hemp† is an annual plant, usually rising to the height of five or six feet. In some situations, it is, however, capable of attaining to a much larger growth. Du Hamel relates, that in some parts of Alsace, hemp plants are found, which reach twelve feet in height, and are more than three inches in diameter at the bottom of the stalk, having such deep roots that the strongest man is not able, unassisted, to pull them out of the ground; and in a new drained marsh, near the Lago di Patria, in the Neapolitan dominions, hemp attained, in 1826, nearly the same dimensions. The fibres of the bark in this plant, like that of flax, comprise the part used in manufacture.

The stalk is channelled and hollow in the inside, containing a white soft medullary substance, enclosed in a very tender tube, commonly called the reed, or, technically, the *boon* of the hemp. It is covered with a green bark, rough and hairy, which is formed of numerous fibres, extending the whole length of the stem. These are not reticulated, but placed parallel to each other, and united by means of the

* Herodotus, book iv. p. 74 The Scythians of Herodotus lived in Europe, north of the Danube, and bordering on the Black Sea.

† *Cannabis sativa.* The word canvas, which is the name for hempen-cloth, is an obvious corruption of this Latin term. The Italians, making but little change, call it '*canape.*'

cellular texture. A microscopic view of these fibres discloses, that each single fibre is itself a bundle of fibrils, of extreme fineness. They are twisted spirally, and, after maceration, may be stretched out to a considerable length. This description may serve to show how well adapted such fibres are for giving strength and pliancy to the articles manufactured from them.

The leaves grow on opposite footstalks, by pairs; they are divided, as far as the foot-stalks, into four, five, or a greater number of narrow segments, pointed, or deeply indented in the margin. The flowers and fruit grow upon separate plants, —the former the male, and the latter the female plant. In general, the male hemp is more slender and delicate than the female. The stem divides itself, at the extremity, into several branches, terminating in thin pointed spikes, while the female plant is surmounted by tufts of leaves of a considerable size. The flowers of the former grow near the summit of the stem, which generally rises about half a foot higher than that of the female,—a creative contrivance, by which the farina or dust that conveys fertility to the seed is readily shed on the latter. The fruit grows in great abundance on the stem of the female plant. This seed is not preceded by any flower; a membranaceous hairy calyx, terminating in long points, encloses the pistil, the base of which becomes the seed. The male hemp is of quicker growth than the female, and sooner arrives at maturity; either kind is produced indiscriminately from the seeds sown, and the difference cannot be known until the plants are somewhat advanced.

Most soils may be made fit, by good manuring, for the cultivation of hemp; but rich, moist earth, is considered the most favourable to its growth. A poor land will yield but a scanty crop; the quality, however, will be proportionally finer. Cultivators are therefore regulated in their choice of soil by the description of hemp they wish to raise. Sir Joseph Banks remarks, on this subject, that 'coarse hemp, such as is required for the manufacture of cables, hawsers, and other heavy rigging, requires every where an abundance of manure, and land of the richest quality.'

Hemp possesses other properties besides the highly useful one of being gifted with fibres capable of conversion into cordage and articles of clothing. Pliny speaks of the root, juice, and other parts of this plant, as possessing wonderful medicinal virtues; and it would seem, that for such qualities it was held, in those days, in higher esteem than for the qualities which now occasion its cultivation.* It is also remarkable for its property of destroying weeds. These are known not to vegetate in a hemp field, whether it be that some peculiar poison resides in its roots, or that it draws off all the nourishment that would otherwise contribute to the growth of noxious plants. This well-known fact is sometimes taken advantage of by agriculturists, to cleanse the land from troublesome intruders. In the swamp near the Lago di Patria, already mentioned, the greatest difficulty, after it was drained, was to get rid of reeds, that rose 'higher than a man on horseback.' The sowing of hemp was found to be by far the most efficacious method.

Russia is the country in which the hemp plant is most successfully cultivated. In 1799, about 600,000 cwt.† were exported in British ships from St. Petersburg alone. This was a period of war, when the consumption of that article was, of course, much increased, as will be readily seem, when it is known that the sails and cordage of a first-rate man-of-war require no less than 180,000 lbs. for their construction. The present importation from that quarter (1837) somewhat exceeds the amount of 1799.

* Thumberg, on a journey from the Cape of Good Hope into the interior of Africa, found the Hottentots cultivating hemp. 'This is a plant,' says he, 'universally used in this country, though for a purpose very different from that to which it is applied by the industrious Europeans. The Hottentot loves nothing so well as tobacco, and with no other thing can he be so easily enticed into servitude; but for smoking he finds tobacco not sufficiently strong, and therefore mixes it with hemp chopped very fine.'

† Assuming that it requires five acres of ground to produce a ton of hemp, the whole space of ground requisite for raising the above quantity, would be 155,670 acres.

TWELFTH WEEK—WEDNESDAY.

VEGETABLE SUBSTANCES USED FOR PAPER.

The invaluable art of writing, by which thought is treasured up in silent repositories, and transmitted, from generation to generation, and the accumulated wisdom of ages is preserved and increased, has given rise to a new use of vegetable substances, which may well be considered as only second to that which converts them into articles of food.

When writing was first invented, the hides of animals, the barks of trees, the broad, strong, and lasting leaves of the palm, or a plain surface of stone or metal, were most probably used. They were succeeded or accompanied, in some countries, by tablets of wood coated with wax, on which the writer engraved his characters with a style, or some other implement.

The first manufactured paper we hear of, was that made from the papyrus,* a species of reed growing abundantly on the banks and in the waters of the Nile ; and this substance continued to be partially employed till about the middle of the seventh century, when its use was, for a time, entirely superseded, in Europe, by parchment,—an Eastern invention.

The papyrus is an aquatic plant ; its roots are large and tortuous ; its stem is triangular, gradually tapering as it shoots up gracefully to the height of fifteen or twenty feet, where it is very slender, and is surmounted by a fibrous tuft of fine filaments, which are again subdivided into others, bearing small seedy flowerets, the whole of the umbel forming a beautiful flowing plume.

Paper was made from the inner bark of the stem of the papyrus, which was divided into thin plates or pellicles, each of them as large as the plant would admit. These plates, after trimming, were laid close together so as to touch, on a smooth table, and then other plates were laid crosswise, when

* Hence the word *paper*.

the whole was watered and pressed; by which means, owing to the glutinous substance contained in the plant, they adhered, forming a sheet of any size the manufacturer might require, and, being dried in the sun, they were fit for use.

Some of these sheets were of great length, and they were always used in the form of a roll. The indefatigable traveller, Belzoni, had a papyrus in his possession, which was twenty-three feet long, by one and a half broad. 'This last,' says Dr. Richardson, 'is the finest and the largest I ever saw.'* The quantities of this manufacture used by the Egyptians, exclusive of what was exported, must have been immense, judging by the remains found in mummy-pits, which have been transmitted to the present day; nor could its exportation have been inconsiderable, as may be believed from the fact, that there are now in the museum of Naples nearly eighteen hundred MSS., written on this kind of paper, which were all dug out of the lava that entombed the ancient Herculaneum, although but a very small portion of that city has as yet been excavated.

The use of parchment, which superseded that of the papyrus, as already mentioned, gave way, in Europe, to that of paper made from cotton, about the beginning of the tenth century. This highly useful substitute appears to have been introduced from Asia; and its history has been thus traced.—The Chinese possessed the art of paper-making at a very early period. By that people it was manufactured chiefly from the young shoots of the bamboo. From them their neighbours, the Tartars, received it, substituting cotton for their material; and these transmitted it, about the beginning of the eighth century, to the Arabs, from whom it was derived by the inhabitants of Europe, either through the commercial intercourse carried on by the Venetians with Syria, or, as some have supposed, by means of the irruption of the Saracens into Spain, who were Arabs under another name.

England was among the last of the European countries into which paper was introduced,—an event which did not

* Travels in the Mediterranean.

take place till so late as the beginning of the fourteenth century. It is only 140 years since writing-paper became an article of home manufacture in this island, though Britain has the merit of bringing it to a higher degree of perfection than any other country. The quantity manufactured in England alone, in 1832, was 53,949,572 lbs; in Scotland, 8,806,780; in Ireland, 2,179,303.

The substitution of linen for cotton, in the manufacture of paper, was a great improvement. The paper produced from the latter substance, indeed, was white, strong, and of a fine texture, but not so durable, nor so well adapted for writing as the paper now in use. The time when this change took place, is somewhat uncertain. In 1762, M. Mirman offered a reward for the discovery of the most ancient manuscript, written on paper made from linen rags; and the result to which his inquiries led him, was to fix the commencement of this manufacture between the years 1270 and 1302. There is, however, a small specimen, since discovered, and preserved in the Imperial Library of Vienna, which carries the date still further back. It is a deed written in the year 1243.—This modification of the art, as well as the art itself, seems to have been derived from Asia.

Various nations use different materials for the purposes of writing. The natives of Ceylon employ, for this purpose, the gigantic leaves of the mountain palm, called by them the talipot-tree, which are so durable, that they have for many ages resisted the ravages of time; the Japanese made an excellent paper from the bark of a species of mulberry-tree; the Tonquinese manufacture paper from silk, and from the rinds of different trees; the Persians use a mixture of cotton and silken rags, which, when made, they polish with a stone or shell; the aborigines of Mexico prepared a kind of material, for their simple hieroglyphics, from the pulpy part of the leaves of the same aloe, which yielded them a grateful beverage, and afforded them a strong cordage.

In the Transactions of the Society for the Encouragement of the Arts, &c., numerous experiments regarding the manu-

facture of paper are detailed; and their library contains a book, written in German, which exhibits between thirty and forty specimens of paper made from different materials. The author of this work was M. Schäffer, an enthusiast, who devoted his life to discoveries in this useful art. The bark of various trees, such as the willow, the beech, the aspin, the hawthorn, and especially the lime, have been successfully formed into paper. The wood, as well as the inner bark of the mulberry; the down of the catkins of the black poplar;* the tendrils of the vine; the stalk of the mugwort; the rind and ligneous part of the nettle; the stalk of the common thistle, as well as the down which envelopes its seed; the bark and stalk of briony; the leaves of the catstail; the slender stalks of the climbing *clematis;* the ligneous twigs of the branching broom; the fibrous stem of the upright lily; and the succulent stalks of the river-weed,—all were alike successfully brought into a pulpy consistence, capable of forming paper, by cohering in thin and smooth surfaces.

Substances yet more unpromising were made to yield to the persevering efforts of this ardent experimentalist. The moss of turf, trees, earth, and coral, as well as cabbage-stalks, wood-shavings, and saw-dust, were successfully manufactured; nay, even the rind of the potato, and the potato itself. This latter substance, indeed, proved a most excellent material, producing a paper extremely smooth and soft to the touch, while its tenacity approached nearer to parchment than any other vegetable substance thus employed, which caused M. Schäffer to esteem it as a valuable drawing-paper.

Perhaps the most interesting of the whole of these experiments, is that which is mentioned of the common fir-top, which is well known to be a hard woody cone, composed of overlapping scales. M. Schäffer's foreman had purchased a bird, whose natural sustenance is the fruit of the fir-tree. On watching the movements of this bird, when engaged in devouring its favourite food, it was observed diligently tearing

* The paper made from these catkins is said to be of very superior quality, being peculiarly soft and silky.

to pieces each scale of the cone, until at length the whole assumed the form of a ball of tow, in which state it was prepared for its food. It immediately struck the foreman, who seems to have imbibed part of his master's enthusiasm, that the fir-apple thus treated might be converted into paper. The hint was taken, and a paper was soon produced, strong and serviceable, and well fitted to be employed as wrapping paper.

In all these details, the reader can scarcely fail to be struck with the adaptations between the vegetable and rational creation, the former affording such interminable scope to the latter, for the exercise of ingenuity, and the reward of judicious labour.

TWELFTH WEEK—THURSDAY.

THE SACRAMENT OF THE SUPPER.

The chief duty I have assigned myself in writing the 'Sacred Philosophy of the Seasons,' is to draw from natural objects, as they unfold themselves in the progress of the revolving year, proofs of the being, perfections, and attributes of the unseen Creator. The importance and the satisfactory nature of the argument thus deducible, has been long appreciated; but still that argument is, and must necessarily be, defective; and we must look to a higher source when we seek for those assurances on which rest all our hopes of future felicity. It is on this very defect, indeed, that the necessity of a direct revelation from heaven is founded. If, in the book of nature, we could have read, and, from the ordinary operations of Providence, could have received, all that was necessary to salvation, there would have been no need of that other book which brings life and immortality to light; or of those miraculous transactions which raise our astonished view beyond the things that are seen and temporal; and we may well believe that, without such necessity, the ordinary course of things,

—the eternal laws of the universe,—would not have been disturbed by messengers from the silent world of spirits.

I have often felt this defect pressing upon me, and longed for more frequent and favourable opportunities of rising to still higher views of the character of the Eternal, and of the future destiny of the human race. Of such opportunities, indeed, I have availed myself in the Sunday papers, and I have sometimes also either found or made them at other times. When they have occurred, I trust my readers have felt, as I have felt myself, that they were as a place of refreshment and peculiar delight, in a journey itself full of beauty and enjoyment.

This period of the year furnishes us with one of these interesting resting-places, which I could not readily excuse myself were I to pass by. It was about the present season that the hopes of the Christian were confirmed and sealed, by the sufferings, death, and resurrection of the Son of God.* Let us, then, break in upon matters of unspeakably inferior importance, that we may attend to the particulars of these aston-

* The period of the Jewish Passover, during the celebration of which Christ was crucified, is not doubtful, because it was expressly fixed by the command of God, and the date is carefully recorded in the Book of Exodus. It was on the evening of the fourteenth day of the first month of the ecclesiastical year, called the month Nisan, and this month commenced in one or other of the three last weeks of the month of March, or the two first weeks of April, according as the period of the new moon was earlier or later; for the Israelites regulated their months by the changes of this luminary, beginning every new month at the new moon. This prevents the possibility of practically fixing down the date of the crucifixion to a precise day or week of the year; but, by attending to the time of new moon, the period may be ascertained with all the precision which appears necessary; though, even then, the looseness of the Jewish method of computing time, seems to preclude absolute accuracy. According to the most approved authorities, the day of the crucifixion must have occurred some time between the 20th March and the 23d April. Both Roman Catholics and Episcopalians, who observe this anniversary, have agreed to celebrate the day of the resurrection on the first Sunday after the first full moon that follows the 21st March, unless that full moon should happen on Sunday; in which latter case, the succeeding Sunday is chosen. The reason for this mode of calculation rests in the fact, that the Passover took place on the fourteenth day of the month, and therefore on the day of full moon.

ishing transactions, as they occurred in succession, during this and the two remaining days of the week, and were consummated on the first day of the following week.

It was upon that day of the week which corresponds to our Thursday, that Jesus, while partaking of the Passover, with his twelve apostles, instituted the holy ordinance of the Supper, in commemoration of his mysterious sufferings, which were to commence that very night in the garden of Gethsemane, and especially of his death on the cross, which was to be inflicted on the next day.

The appointment of this sacred rite, in itself so important, in its manner so beautifully simple, and, in the time chosen for its first celebration, so deeply affecting, was entirely in harmony with the character of Jesus, and with the pure and humble spirit of his religion. His tremendous sufferings lay at that moment open to his prophetic view, and were pressing heavily on his soul. But not with his own woes did he occupy his thoughts. His care was to provide consolation and encouragement to his disciples. 'Having loved his own,' as an apostle beautifully expresses it, 'he loved them to the end.' He resolved to leave them, under circumstances so affecting, a pledge of his enduring love, which, as a dying gift, might gratify their feelings, and, as a solemn religious rite, commemorate the blessings about to be procured for them by his death, while, in the act of commemoration, they might receive a sign and a seal of these blessings.

For such a pledge he sought not in any splendid or expensive ceremonial. He had recourse to the ordinary food, of which they were then partaking, and found, in bread and wine, the most expressive and the most appropriate of emblems. *Bread*, the staff of man's natural life, most aptly represented Christ, the staff of man's spiritual life: Bread *broken*, strikingly indicated the death of torture which the Saviour was to endure for his people: Bread *eaten*, was a fit type of the inward reception necessary to be given to the doctrine of the cross, before it can contribute to our spiritual nourishment. In the same manner *wine*, with its vivifying influences, beauti-

fully shadowed forth the blood of Christ, blood being the natural vehicle of life to the human body. Wine *poured out*, exhibited the shedding of his blood, that is, the sacrifice of his life for the remission of sin: Wine *tasted*, indicated the personal application of that blood of atonement, that is, its appropriation, by believers, each to himself,—so indispensably necessary to salvation.

Thus the action itself, united with the time and manner in which it was performed, was calculated to make the deepest and most salutary impression, not only on the apostles, with whom it was personally transacted, but on all the disciples of Jesus, to the latest generations, who should, from them or their successors, receive the hallowed rite.

And this impression it has actually produced. In all the severe trials which those holy men who sat with their Divine Master, at the feast of communion, had to endure in their future lives, the pledge of his love thus so condescendingly and affectingly given,—the memorial of his death, then so solemnly instituted,—formed a ground of unspeakable consolation, and a never-failing source of strength and enjoyment. It was at the table, where their beloved Saviour had himself personally presided, that the apostles renewed their communion with this best of friends; heard once more the gracious words which he uttered; were again enlightened, encouraged, and consoled by his presence; and saw him, with the eye of faith, as they had seen him with their bodily eyes, distributing to them those symbols of his expiatory sufferings and death, they were so soon to witness. How vividly and overpoweringly would the whole succeeding scene, at these moments, rise to their awakened view,—the agony in the garden, the insults of the judgment-hall, the torture of the cross;—and, along with these, his exhortations, his assurances, his words and looks of pity and unextinguishable love;—and, above all, that proof of affection, stronger than death, which he exhibited, when he bore the punishment due to their sins, 'in his own body, on the tree.'

Events so impressive, thus impressively recalled, could not

fail deeply and permanently to affect their minds. No wonder that, when animated by such a memorial, they endured persecution and contempt with patience; nay, when condemned to the scaffold or the stake, rejoiced that they were counted worthy to suffer in the service of a master endeared to them by so many ties.

Similar effects have been produced in the minds of communicants, from the days of the apostles to the present hour. Whatever, in the whole history of the church, has been lovely or of good report, received its origin or its encouragement in this solemn act of communion. The confessors, the martyrs, the reformers, who stood forward, in the midst of inveterate foes, to bear testimony to the truth as it is in Jesus, and whose names are in the churches as ornaments of religion, and benefactors of an ungrateful world; and not less, though in a more humble sphere, the innumerable company of private Christians, who walked through this vale of tears, looking to Jesus, and whose names, forgotten perhaps on earth, are written in the imperishable records of heaven,—these all renewed their vows, confirmed their faith, and cherished their graces at the table of him who loved them even to death. There, the Christian penitent has received comfort, the Christian pilgrim food and refreshment, the Christian soldier energy to contend against, and strength to overcome, all his enemies; and there will his disciples continue to receive spiritual nourishment and growth in grace 'until he come.'

TWELFTH WEEK—FRIDAY.

THE CRUCIFIXION.

The astonishing event predicted in ancient prophecy, frequently alluded to by Jesus in his intercourse with his disciples, and typically represented on the preceding evening in the Sacrament of the Supper, was now to be accomplished;—Christ, our Passover, was to be sacrificed for us. In the

agony of the garden, which quickly succeeded the institution of the Eucharist, the concluding scene of the Saviour's life may be said to have commenced. He was then subjected to a torture of soul which God alone could inflict, and the Son of God alone could endure. The bloody sweat, and the prayer for mitigation, are awfully expressive of the unspeakable intensity of the mysterious sufferings of that hour of the powers of darkness.

There were, indeed, crowded into a few short hours a complication of horrors, on the one hand, and manifestations of fortitude, of patience, and of Godlike love, on the other, which it is impossible to contemplate without amazement, and every one of which might well call forth a lengthened homily, on the blindness, ingratitude, and rebellion of man, and the boundless mercy and grace of the Redeemer. But I hasten to the last act of brutal ferocity with which the transactions of these most memorable of all days were crowned.

Crucifixion was a punishment appropriated to slaves guilty of some atrocious crime. It was a death of torture as well as of infamy, and in extorting from his cowardly and worthless judge his condemnation to this punishment, the intention of his enemies, doubtless, was not merely to gratify their malice, —though there is nothing more inveterate than the fierceness of religious bigotry,—but to stamp disgrace upon his pretensions, by causing his end to contrast so fearfully with the high character he assumed. But they were thus, unknown to themselves, fulfilling the gracious designs of the Eternal. Their worldly hearts refused to believe the prophecies which predicted a suffering Saviour. They were, therefore, wilfully ignorant that Messiah was to be 'cut off, but not for himself;'* that he was to be 'led as a lamb to the slaughter,' and wounded for transgressions not his own, 'the Lord laying on him the iniquities of us all.'† It is thus that God turns the wisdom of the wise to folly, and entraps the wicked in their own net.

The last hours of our Lord's life were but a more vivid

* Dan. ix. 26. † Isaiah liii.

and concentrated exemplification of that Divine dignity, mingled with human lowliness, which characterized the whole life of Jesus, and marked him as at once the Son of God and the Son of man. From his birth to his death, we see the Godhead constantly breaking forth through the veil of humanity, and shining more glorious in the midst of moral darkness, like the sun when he bursts in a day of storm through troubled clouds.

Let us look at the scene before us—Jesus is nailed to the cross. To all human appearance he is a helpless mortal, coerced by superior power, and however meekly he yields, yet forced to yield to the cruel sentence of the law. He shows no reluctance. He utters no complaint. He has borne every indignity without even a look of resentment,—and now he submissively bends his body to his persecutors as they proceed with their wretched task. All this, however, might be construed by his enemies into the obduracy of despair. But is there nothing more?—See! He raises his eyes to heaven. It is in prayer. He speaks.—'Father forgive them, for they know not what they do!' These simple, but most memorable words, reveal at once the inward current of his thoughts, and breathe forth, in that hour of bodily anguish, the very spirit of peace and love with which his religion is fraught.

Another instance of the same generous disregard of self, and tender attention to the welfare of others, which so strikingly marked the character of Jesus, was displayed in an incident noticed by the apostle, whom it more immediately affected; and I state it, without further comment, in the simple words in which it is recorded. 'Now, there stood by the cross of Jesus his mother, and his mother's sister, Mary, the wife of Cleophas, and Mary Magdalene. When Jesus therefore saw his mother, and the disciple, standing by whom he loved, he said unto his mother, "Woman, behold, thy son." Then said he to the disciple, "Behold thy mother." And from that hour that disciple took her to his own home.'* I do not know that any words could convey a more impressive

* John xix. 25–27.

view of deep and tender affection triumphing over the pangs of torture, or could present, in a more endearing light, that character, the most remarkable feature of which was *love*.

There is yet another incident recorded to have occurred while Jesus was hanging on the cross, and undergoing a lingering death by torture, which is strongly characteristic, and is full of hope to the penitent. He had been crucified between two thieves. One of these, true to the hardening nature of his desperate profession, joined with the infuriated mob in reviling him; but the other, in that latest hour of his life, having had his darkened heart enlightened by a ray from heaven, saw the glory, unseen to the eye of sense, which surrounded the person of his fellow-sufferer, and, with surpassing faith, exclaimed, 'Lord, remember me when thou comest into thy kingdom!' Instantly the prayer received a gracious answer. 'Verily, I say unto thee, to-day shalt thou be with me in paradise.'

Of the occurrences which took place during the period of the Crucifixion, there was one of a miraculous nature, which could not fail to affect the beholders with awe, striking terror into the hearts of Christ's enemies, and filling his friends with a trembling and short-lived hope. It is mentioned by three of the evangelists, with that beautiful simplicity which is so characteristic of their writings. 'Now, from the sixth hour there was darkness over all the land until the ninth hour.' It was during this mysterious darkness that Jesus, oppressed with a sense of desertion, which formed the climax of his sufferings, exclaimed, in the prophetic words of the 22d Psalm, 'My God, my God, why (or rather how far) hast thou forsaken me!' and then, after an interval, during which his vicarious sufferings were completed, and a guilty world was saved, he again raised his voice, exclaiming, 'It is finished;' and last of all, bowing his head, and saying, 'Father, into thy hands I commit my spirit,' he yielded up the ghost. 'And behold the vail of the temple was rent in twain from the top to the bottom, and the earth did quake, and the rocks rent; and the graves were opened; and many bodies of the

saints that slept arose, and came out of the graves after his resurrection, and went into the Holy City, and appeared unto many.'*

It is added, that even the Roman centurion, who guarded the Crucifixion, was so struck with the supernatural scene, and with all that he had witnessed, that he called out in sudden conviction, 'Truly, this was the Son of God!' In this sentiment his soldiers are recorded to have sympathized; and, when we reflect, we shall not be surprised that, heathens though they were, this effect was produced on their minds. They had been officially appointed to preserve order during the execution of three individuals condemned to the ignominious death of the cross, of whom, one, as they had probably heard, was held by some to be the Son of God, while, by the Jewish rulers, he had been accused of blasphemy for assuming this title, and had, in consequence, been condemned by the Roman Governor. Their curiosity might probably be excited by such an account, vague as it was; and it was natural for them to watch with some interest, during the trying scene, the conduct of one whose pretensions were so high. From the scoffs and insults of the infuriated rabble, their attention would therefore be turned on the meek and patient sufferer. How unspeakably must they have been struck with his whole deportment, so totally unlike that of a hypocrite or blasphemer. His look of earnest entreaty, when he raised his compassionate eyes to heaven, and prayed for his murderers; of tender affection, when he turned them on his mother and his friend, and directed their love for him into sympathy towards each other; of Godlike dignity, when he accepted the petition of the penitent thief, and pronounced his salvation; of soul-withering anguish, when he writhed under the consciousness of abandonment by his God; of triumphant joy, when to him the returning smile of his Father announced that the victory was gained, and the sacrifice for sin was complete; of confidence in a Father's love when he bowed his head and died—all these varied actions and emotions—so ad-

* Matthew xxvii. 51–53.

mirable—so divine—so astonishingly contrasting with his outward circumstances—must have affected the mind of a disinterested spectator, even more powerfully than the miraculous darkness, the earthquake, and the rending rocks; and they render the exclamation of the centurion no other than the voice of Nature itself.

Truly, this is the Son of God!—Yet he was not so esteemed by the Jews. And how many of the children of men—of that guilty race, for whose salvation he thus generously suffered—have, from that day to the present, proudly scorned and rejected him! It would seem as if they were more insensible than inanimate nature, which sympathized in his agony. This solemn sentiment is feelingly and indignantly expressed by an Italian poet;* and I close the present paper by quoting it from the fine translation of Montgomery, a kindred spirit.

'I asked the Heavens—"What foe to God hath done
This unexampled deed?" The Heavens exclaim—
"'Twas man—and we in horror snatched the sun
From such a spectacle of guilt and shame."

* * * * * *

'I ask'd the earth—the earth replied aghast,
"'Twas man—and such strange pangs my bosom rent,
That still I groan and shudder at the past."—
To man—gay, smiling, thoughtless man, I went,
And asked him next.—*He* turn'd a scornful eye,
Shook his proud head—and deign'd me no reply.'

TWELFTH WEEK—SATURDAY.

THE GRAVE.

If we could transport ourselves in imagination to the morning of the day which succeeded the Crucifixion, we should be able to form a better estimate of the feelings which perplexed and agitated the minds of the disciples. The Shep-

* Cresembini.

herd was smitten, and the flock was scattered. They had trusted that this was he who should redeem Israel;—but what could they now think? They probably did not give up all hope even when they saw him extended on the cross. Perhaps they remembered his words, which appeared to them so mysterious when they were uttered, 'I, if I be lifted up from the earth, will draw all men unto me.' This, and various expressions of a similar import, are not unlikely to have kept their faith in exercise during the awful scene; and, having banished from their unwilling minds all that he had predicted concerning his death, they may have anxiously expected, even at this eventful hour, some miraculous interference to confirm all their fond anticipations. His triumphant enemies were heard to exclaim in derision, 'Let him now come down from the cross, and we will believe him;' and it may have seemed to their half informed minds a fitting opportunity for the Eternal to interpose and vindicate the insulted majesty of his own Son. The miraculous darkness which succeeded, the earthquake, and the rending of the rocks, would all seem to them to confess a present God, and they doubtless flattered themselves that their hopes were at last about to be realized.

But when their Master gave up the ghost, and all these indications of Divine wrath passed away, their depression would naturally become as deep as their previous hopes were high. They saw him dead and buried, and they felt as if all their hopes were buried with him. There he lay in the silent tomb, while Nature resumed its wonted course. The evening sun had set as glorious, and risen as serenely to bless the smiling earth, as if he had not withdrawn his beams, and refused to look on, while the deed of horror was doing. It was thus that the Jewish Sabbath began, and thus it ended. Never, assuredly, was God's hallowed day spent by holy men in such despair.

It was ignorance, however, of an essential doctrine of our most holy faith—for even the apostles had still much to learn—which gave rise to this despair. They had yet to be taught

the fundamental truth, that Christ had died a sacrifice to satisfy divine justice, himself at once the Priest and the Victim. Had they but got a view of this invaluable doctrine, their perplexity would have been changed into admiration, and their despair into hope and joy. They would then have perceived with devout adoration, that if God's ways are not as our ways, it is because as heaven is higher than the earth, so are his thoughts higher than our thoughts.

The doctrine of substitution had long been familiar to the Jews, and was indeed intimately connected with various parts of their peculiar polity. Vicarious punishment, in particular, was recognized in their sacrifices, the animal slain at the altar being understood to bear the punishment due to the sins of him who offered the expiatory sacrifice. Perhaps by those only whose minds were divinely enlightened, were these offerings known to have a deeper meaning, and to derive all their efficacy from that one great sacrifice, which was to be offered up once for all for the remission of sins. But, howsoever this may be, it is at least certain, that these acknowledged substitutions prepared the way for the more ready reception of that great doctrine, which lies at the foundation of all our hopes. And, what is not a little remarkable, the very same doctrine was extensively diffused over the heathen world—the sacrifices which they offered up to their false deities, depending on precisely the same principle of vicarious punishment.

It is this essential and mysterious doctrine, which shows the necessity of another doctrine, equally essential and equally mysterious—that of the incarnation of the Second Person of the Godhead. The argument may, in few words, be stated thus:—Man is a sinner; but the holiness of God, who is of purer eyes than to behold iniquity—and the justice of God, which is infinite, and therefore inexorable, required the punishment of sin. Hence sin could not be forgiven;—but it might be atoned for—that is to say, it might be punished in the person of a substitute. In such a substitute, however, some very peculiar qualities were necessary. These may be

understood by comparing sin to a debt, and the substitute to a surety. The surety is one who is not naturally bound to pay, but who voluntarily substitutes himself in place of the debtor; and, before he can be accepted, it must be shown that he has the means of discharging the debt. Apply these principles to Christ. He voluntarily offers himself as our surety; and seeing our desperate circumstances, the love which induced him to do so, could be nothing short of infinite. But is he able to discharge the debt? Assuredly not, if he be a mere man,—even although he be a sinless man; for, in such a case he is a *creature;* and creatures have nothing to give to the Creator. Every thought, and word, and action of their lives, the whole powers and faculties of their bodies and their souls, are already due to Him from whom they derive their being. They are already indebted, to speak in the language of the metaphor we have employed, up to the utmost extent of their means on their own account; they cannot, therefore, pay what is due by others. This view includes the highest, as well as the lowest orders of created intelligences; and angels and archangels are not less impotent for such an object than man.

This shuts us up to the belief, that no one inferior to God himself,—the uncreated, independent God, could make the necessary atonement. How then?—Can God suffer? Can God die?—Impossible! It was necessary that the atonement should be made in the created and mortal nature which had offended. And here we see a solution of the most amazing and mysterious of all enigmas,—'God manifest in the flesh.' It behoved the Redeemer to be man, that he might suffer; it behoved him to be God, that the atonement might be independent, efficacious, and complete.

How amazing is all this! How infinitely beyond the powers of the human mind to comprehend! Paul, in adverting to the subject, in his epistle to the Ephesians, seems deeply impressed with the inadequacy of language to give utterance to the feelings which it is calculated to inspire; and prays that God would grant them to be 'strengthened with all

might by his Spirit in the inner man, that they might be able to comprehend what is the breadth, and length, and depth, and height,—and to know the love of Christ, which passeth knowledge.' In the whole of that remarkable passage, and in similar passages of this apostle's writings, there is a labouring for words which is exceedingly striking; and this corresponds with the experience, and calls forth the sympathies, of all who have attempted to form some distinct conception of the subject, the vastness of which no created intelligence can adequately grasp. 'These things the angels desire to look into.'

THIRTEENTH WEEK—SUNDAY.

THE RESURRECTION.

Once more we have been permitted to see the light of a returning Sabbath,—another day of the Son of Man. Again are we called upon to pause amid our worldly occupations, and, looking around us, to 'praise the Lord for his goodness, and for his wonderful works to the children of men.' When we look abroad upon the wakening earth, the green resurrection which everywhere refreshes the eye, peculiarly harmonizes with the contemplations which arise in the mind on such a Sabbath as this. But what is the winter of the natural year, compared to the desolate feelings of the disciples at the hour when they saw the remains of their Lord laid in the sepulchre. Their love, their hope, their mysterious and undefined faith, were all entombed there, and they knew not where to turn for consolation. Those of them who, restless and agitated, arose before day, desiring in some degree to alleviate their woe, by paying a small tribute of respect to the remains of their Master, were even in this to be disappointed. What must have been the shock to their feelings, when the idea forced itself on their minds, that perhaps even fresh indigni-

ties were to be exercised on the lifeless frame of him whom their souls loved. It was winter in the soul of Mary when she replied to the—'Woman, why weepest thou?' of the angel, 'Because they have taken away my Lord, and I know not where they have laid him.' We cannot fathom her suppressed anguish, when she petitioned the supposed gardener, 'Sir, if thou have borne him hence, tell me where thou hast laid him, and I will take him away.' If such was her agony, what then must have been her joy, when she found her living and risen Lord so near, and uttered the word—'Rabboni.' The simplicity of the Gospel narrative warns me to beware of attempting to describe or amplify such emotions. That they were sustained, and that the revulsion of her feelings did not overwhelm her mind, or drive it to take refuge in insensibility, was, because He who knoweth our frame and remembereth we are dust, regarded the low estate of his handmaiden, and caused her spirit to be strong and to rejoice in God her Saviour. 'Blessed is she that believeth.' Here was a revolution, of which the change from winter to spring forms but a feeble exemplification! What is the enjoyment of all that can regale the bodily senses,—what is the promise of abounding corn and wine, compared to this! Each returning Sabbath, is designed to commemorate the resurrection of the Anointed One from the grave. But more than each returning Sabbath does the anniversary of the real day, lead us to sympathize with these mourning and rejoicing disciples, the depth and variety of whose emotions, we cannot, with the utmost stretch of our imagination, hope to realize.

It was on this day, that, 'having finished his work, having suffered the penalty due to guilty man, the Redeemer burst asunder the bands of death, and, issuing from the portals of the tomb, afforded, not to the disciples alone, but to believers in every age, the pledge that his expiation had been accepted, that his victory was complete, and that, 'like as he was raised from the dead by the glory of the Father, even so they also should walk in newness of life.'

By his resurrection, Jesus sealed the truth of all which he

had taught on earth, and proved that he who, as God, 'had power to lay down his life, and had power to take it again,' had power also to confer upon his servants those rich rewards, which he promised, which he purchased, and which he has ascended to his Father's right hand to bestow.

When the deriding multitude cried out, 'He saved others, himself he cannot save,' how little could they comprehend the reason why he could not save himself. Could not He have 'come down from the cross,' who could not be holden even by the grave? How easily could the legions of angels, who hovered spectators of the solemn scene, had they been commanded, have manifested themselves to the sight of these scoffers? All their powers of just indignation, of holy reverence, of astonished and offended veneration, were ready to spring forth, for the destruction of the impious throng, who were parties to the dismal transaction. But one power, stronger than all these, withheld them. On account of that one power 'himself he could not save.' And what was that power? Love,—love that submitted to ignominy,—that contemned anguish,—that endured wrath,—that was stronger than death,—that was more powerful than the grave,—love that suffered no shadow of change, till the Saviour could exclaim, 'It is finished;' till he could send to his brethren, and say, 'I ascend to my Father, and your Father, to my God, and your God.'

'Himself he cannot save!'
This is his highest praise:
Himself for others' sake he gave,
And suffered in their place.

'It were an easy part
For him the cross to fly;
But love to sinners fill'd his heart,
And made him choose to die.'

Had not the Saviour risen from the dead, our faith must have been vain;* as Christians, of all men, we must have been the most miserable, and our last moments must have

* See 1 Corinthians, chap. xv.

been darkened by the horrors of unmitigated despair. But (blessed be God!) we are not left in doubt. 'Christ has conquered death, and him that hath the power of death, even the devil.' He has risen, and has 'become the first fruits of them that sleep.' To this we look, as the ground of that 'hope, which is full of immortality.' Difficulties we may have to contend with; tribulation we may have to endure; and in death we *must* lie down. But if we are in Christ, we shall be enabled to bear up amidst all that is calculated to agitate and alarm us, and to look beyond death and the grave, to that bright and unfading inheritance, where Christ sitteth at the right hand of God, as our Mediator and Advocate, and from whence he shall come and 'receive us unto himself, that where he is, there we may be also.' Are we destined to endure persecution for righteousness' sake? Is the ridicule, the contempt, and the hatred of thoughtless worldlings to be our portion? Let our souls be animated, and our spirits cheered, by the reflection, that, in all our sorrows, we are sympathized with by our risen Saviour, who 'endured the contradiction of sinners against himself,' and 'by whose stripes we are healed,' who will strengthen us for the faithful discharge of duty, and who at length will bestow upon us that 'crown of life,' which will far more than compensate us for the toils and dangers of our conflict here.

Are we oppressed with the complicated sorrows of life? Still we are forbidden to despond. The Son of Man 'had not where to lay his head;' he was a wanderer and an outcast; he wept, he groaned, he suffered,—and now he reigns in glory. He was like us once, but he has *risen;* and, 'when he shall appear, we shall be *like him*, for we shall see him as he is.' Have those who are dearest to out heart, and loveliest in our eyes, been snatched away from us by death, and must we too encounter the shock of dissolution? Still let us look to Him 'who died for our offences, and rose again for our justification,' and who has said, 'Because I live, ye shall live also.' And let our faith in him, as 'the Resurrection and the life,' be strengthened, when we remember, that the body in which our Lord

appeared on earth, in which he suffered and died, and in which he rose again, was in every respect similar to our own. That same body, which was subject to pain and ignominy, and which was laid in the grave, he has carried with him—now a glorified body—into heaven, and will retain for ever upon his eternal throne. And shall not this body which I inhabit be also raised again from the tomb, and, having all its vileness purged away, 'be fashioned like unto his glorious body,' and be for ever in his presence, and in the enjoyment of 'his favour, which is life?'

Trusting to those laws of Nature which the Almighty has established, the husbandman does not fear to commit the precious seed to the bosom of the earth, well knowing that there it shall lie safe and unharmed by the desolating tempests that sweep above it, till the voice of Spring shall bid it awake, and put forth its dormant energies. And with yet greater, with perfect confidence, may the Christian resign this frail and perishing body to the darkness and corruption of the tomb, assured that there it shall securely rest from all the strife and turmoil of this evil world, till that morning shall dawn, when the quickening voice of the archangel, and the blast of the trump of God, shall call it forth, renewed and purified from all imperfection, to meet with a risen and reigning Saviour, and with those departed ones who have 'fallen asleep in Jesus,' and whom 'God will then bring with him.' J. R. D.

THIRTEENTH WEEK—MONDAY.

ENJOYMENT EQUALLY DISTRIBUTED.

Man is an animal of all climates; and in them all, though differing in complexion and in some minute particulars of form, he is essentially the same. His various tribes gradually shade off, as it were, one into another, along with the climate and productions which surround him; but when we compare the extremes of his condition, the contrast is very striking;

and it is no mean proof of benevolent arrangement, that the same physical and mental powers should be capable of being accommodated to such opposite circumstances.

Let us figure to ourselves an inhabitant of some peculiarly favoured spot, with all the powers of nature contributing to his gratification,—the clear blue sky above his head, shaded occasionally by clouds which drop down fatness in fertilizing showers;—the green earth beneath his feet, throwing from her bountiful lap a profusion of flowers in every form of loveliness;—around him venerable trees, full of leafy honours, stretching wide their branches, to afford him a grateful shelter from the meridian heat, or teeming with fruit to gratify his taste;—hard by, the sparkling of a cool transparent stream, as it hastens to join the broad river, flowing majestically through meadows of emerald, to lose itself in the distant ocean;—in his groves, birds of varied notes cheering him with their sweet music;—on his lawns the lowing of cattle, on his hills the bleating of sheep;—in his stables, beasts of draught to cultivate his fields, and of burden to convey him swiftly and at his ease on distant journeys;—in his house, all the comforts, conveniences, and luxuries which commerce has collected from distant climes, and ingenuity has prepared for his use;—in his family, servants obedient to his nod,—a beloved partner of his bosom, and dutiful children, who kindle while they reflect the glance of a parent's eye.—Such is civilized man, favoured by Heaven in a land overflowing with the gifts of nature.

Look now at the opposite picture presented by the inhabitant of the frozen north. For him no tree waves, no verdure smiles, no flowers display their beauties or diffuse their sweets; the rigid earth rings beneath his feet, or is hid from his view in its cold and cheerless mantle of snow; no fruits drop to please his palate; scarce a vegetable springs from the barren earth to contribute to his subsistence; he hears no music of birds, no lowing of cattle, no bleating of sheep; all around, not a whisper is breathed, unless when the solemn and profound silence is interrupted by the occasional sound of the hu-

man voice, or the raging of the tempest, or, perchance, the growl of the polar bear, or the wolf's long howl, or the barking of the domestic dog, the devoted companion of man in every region of the earth. His house is a temporary structure of snow, to be dissolved when the sun, absent for many a dreary month, again raises himself in the heavens, and cheers the scene with his languid smile, or a rude hut of earth and stones, to be abandoned when hasty winter again comes to extend his rigid sway over that region of gloom. In such a land of sterility it would be impossible for human beings to exist, were it not that what the niggardly soil denies, is supplied by the prolific ocean; and the native, rendered inventive by necessity and adventurous by habit, has discovered the means of drawing his subsistence from the bosom of the deep, by boring the solid ice, or launching his slender skiff on the stormy waves.

To the man who has been accustomed to the comforts and conveniences of a genial clime, nothing can be more repulsive, or more full of horror, than such a condition as this. To him it seems passing strange that a fellow-creature should possess sufficient energy of mind to survive such a complication of evils. Yet he not only survives, but enjoys life. So true is this, that if we regard mere animal gratifications, it may justly be questioned if the inhabitant of the most favoured climate, amidst all his abundance, has in reality a greater share of pleasure than the inhabitant of the polar regions in his wastes of snow; and if we regard mental enjoyments, these depend so much on circumstances unconnected with external comforts and possessions, that still their superiority may be doubtful. There is nothing to create a smile in the question, whether the patient, humble, pious Greenlander, scantily supplied though he be with natural light and warmth, but illuminated by the Son of Righteousness, is not as happy in his inmost soul as his brother of earth, the servant of the same Master, and the cherisher of the same immortal hopes, when surrounded with all the luxuries of the East.

There appears at first sight to be something paradoxical in

this statement; it is, nevertheless, capable of being supported on satisfactory grounds. When we come to analyze and practically to examine the enjoyments arising from the mere gratification of the senses, we find them subject to many abatements. Long possession satiates—constant indulgence cloys—the pampered appetite becomes dainty and craving. There is a point beyond which delight changes its very nature, and is converted into pain;—

> 'Tis pleasure to a certain bound,
> Beyond 'tis agony.

When we deduct all these circumstances from the sum of enjoyment; and when we farther remember that over-indulgence in any of the grosser gratifications of the senses, induces disease, premature old age, and death, we will be forced to detract materially from the amount of enjoyment received from this source, even where the means of indulgence is unlimited. The truth is, that we are not formed for the intense and constant gratification of our appetites and passions; and he who violates the moderation of nature in this respect, may lay his account with suffering the punishment due to his selfishness. This result is altogether independent of remorse of conscience, which is another element that occurs to limit most materially the bounds of corporeal enjoyment.

If we now turn again to the simple inhabitant of the northern regions, we shall find, that as his fellow of the south has his means of physical gratification limited and fettered, so to him the susceptibility of physical discomfort is abated with an indulgent hand. His body is rendered, in a great measure, callous to the sensations of cold, and, wrapped in his skins, he can sleep as sweetly on a bed of snow, in a dwelling of snow, as the most luxurious of the children of more genial climes can rest on a couch of down, in an apartment where art has lavished all her refinements. If his appetite has been less delicately pampered, it is at least accommodated to the fare provided for it; and those who have witnessed the inhabitants of Labrador, indulging in a plentiful meal after a period of

necessary abstinence, will not hesitate to place the pleasures of the feast at least on an equal footing with those enjoyed by the most refined epicure, when gloating over some favourite repast.

Thus equally are the pleasures derived from our physical constitution, divided among the human family. With regard to intellectual enjoyment, its distribution is every where partial, depending, as it does, in every climate, upon mental improvement; and it is only enjoyed more abundantly in less sterile regions, because opportunities of improvement are more abundant. The time was, however, when even remote and dreary Iceland was enlightened, by the beams of science, and, till this day, her natives alleviate the tedium of their gloomy winter by the enjoyment of their intellectual feasts. But where this source of pleasure is wanting, there is at the same time wanting all knowledge of the privation. The desires and the hopes of the untutored natives are limited to their means; and this adaptation is another proof of the beneficent administration of a Father-God.

Such considerations lead us to the conclusion, that, under all circumstances of climate and produce, enjoyment, so far as it depends on physical condition, is far less unequal than might at first sight be supposed; and we are, at the same time, reminded that it is vain for us to expect very intense satisfaction from the mere indulgence of the senses, destined, as we are, to aspire far higher, and to drink of happiness far deeper; and as to this purer and nobler happiness,

'Tis nowhere to be found, or everywhere.

THIRTEENTH WEEK—TUESDAY.

THE ENJOYMENTS OF THE POOR IN SPRING.

This is truly the glad season of the year. Wherever we turn our eyes, Nature wears a smile of joy, as if, freed from the storms and cold of winter, she consciously revelled in all

the luxury of Spring. The lengthening day, the increasing warmth of the air, and the gradually deepening green of the awakened earth, excite in every breast a lively sense of gratitude, and pleasingly affect the imagination. A walk among the woods or fields, in a calm spring day, when the trees are bursting forth into beauty, and all the land is echoing with song, may well soothe the stormiest passions, and inspire that 'vernal delight,' which is able 'to drive away all sadness but despair.' The mind sympathizes with the joy of inanimate nature, and rejoices to behold the reviving beauty of the earth, as if itself had escaped from a period of gloom, to bask in the sunshine of hope and enjoyment.

We are familiar with the joys of Spring, as felt or described by poets and other ardent lovers of Nature. They form the burden of many a poetic strain, and excite to many a meditative reverie. They have inspired enthusiasm and deep delight, ever since there was an eye to witness, or a mind to feel, the harmony and loveliness of this gorgeously-arrayed and breathing world. They are the source of exquisite emotion to every mind, in which dwells a sense of beauty and creative design. They also light the brow of care, and bring back the flush of health and hope to the pale and wasted cheek. And not only by the rich and the unenlightened,—by the children of luxury and mental refinement—are the fine and indescribable delights of this season deeply felt and valued;—spring is also a time of increased enjoyment to the poor. It fills the inmates of many an humble dwelling with gladness, and makes even desponding poverty smile and hope for better days.

There is something in the flowery sweetness and genial warmth of spring that kindles in the rudest bosom feelings of gratitude and pleasure. The contrast to the cold and desolation of winter is so striking and agreeable, that every heart, unless it be hardened by the direst ignorance and crime, is melted to love and pious emotion; and breathings of deep-felt adoration escape from the most untutored ips. The carols of the ploughman, as he traverses the field the live-long day,

and turns up the fresh soil, seem to bespeak a lightsome heart, and evince the utmost joyousness of labour. The shepherd, as he sits upon the hill-side, and surveys his quiet flock, with its sportive companies of lambs, those sweetest emblems of innocent mirth,—feels a joy and a calm satisfaction, that is heightened by the recollection of the vanished snow-storms of recent winter, and of all the anxieties and toils attending his peculiar charge. Even the hard-working mechanic of the village or town shares the general gladness of the season. As he strolls in sweet relaxation into the glittering fields, or along the blossoming hedgerows and lanes, haply supporting with his hand the tottering footsteps of his child, or carrying the tender infant in his arms, he breathes the freshening air, treads the reviving turf beneath his feet, and inhales the first faint perfumes, and listens to the first melodies of the year, with an enjoyment that his untaught powers of expression cannot describe. The children of our cottages also,—whose lot is often poverty approaching to want, and whose joys are always but limited, and of the humblest kind,—appear in their own manner, to enjoy the fine days. How many happy hours they now spend basking and sporting upon the sunny hill, or gathering wild flowers by the brook, building the frail house of turf and green boughs, or plaiting the little rushes into every fantastic shape! And with what delight do they search for, and find the bird-nest at the hedge-root, or among the blossoming furze! Would that their own sympathies taught them to spare the tender brood, and the feelings of the fond mother, while they revel in those rural and healthy sports, by which a kind Providence has counterbalanced their numerous privations!

In the country, there is usually least demand for labour in winter, when agricultural operations are either necessarily limited, or are retarded by the severity and changeableness of the weather. The poor labourer, whose family depends, from day to day, upon the proceeds of his toil, is thus frequently thrown out of employment, when the rigours of the season render it most necessary. In the long winter months,

his supply of food is often scanty, and fuel is, perhaps, also wanting, to make his hearth cheerful, and keep out the piercing cold. But with spring come more certain and pleasant labours, longer and more genial days, soft winds, and warming sunshine; and then his wife and family, the dear partners of his privations, share with him a more liberal supply of the necessaries of life, and, stirred by the sweet influences of the season, bless with him the bountiful Author of Nature, who forgets not, but kindly regards, the humblest of his children. In the calm spring evenings, what delightful hours the cottager spends in his little garden! With a heart buoyant with enjoyment, he delves the useful plot of ground, and, in joyful hope, commits to the earth his few simple plants and seeds. He is surrounded with officious little labourers, who strive to assist him, but haply only mar his work, and whose attention is divided between the business of the evening, and the violets and daisies that spring up in the turf-walk beneath their feet. He is not without a feeling,—unuttered though it be,—of the sweetness of spring, and the delights of the passing hour; for, as the shades of night fall darkly on the scene, he leans upon his spade, and lingers to breathe the odorous air, to hear the faint murmur of his wearied bees, now settling peaceably in their hive for the night, and the glad notes of birds dying melodiously away in the inner woods.

Cowper, that most delightful of poets, has, with exquisite feeling and beauty of expression, thus alluded to the enjoyments of the poor at this season:—

> 'Even in the spring and play-time of the year,
> That calls the unwonted villager abroad,
> With all her little ones, a sportive train,
> To gather king-cups in the yellow mead,
> And prick their hair with daisies, or to pick
> A cheap but wholesome salad from the brook.'

Here we have a picture, which we hope is not merely ideal. It must surely be a pleasure to all, to consider it as copied from Nature. It is customary, we know, to estimate at a small amount the sensibilities of the poor, and to paint

poverty as a state of life unblest by any of the finer emotions. But, though it must be admitted that extreme poverty too frequently demoralizes and hardens the character, by fostering a sullen discontent, and giving rise to a spirit of gloomy desperation, how often do we find, even among the poorest classes, a strong though uncultivated sentiment of natural beauty, a keen sense of rural enjoyment, along with all the unsophisticated feelings of our nature? God hath not so partially distributed happiness, as to exclude the meanest of his children from the joys peculiar to this animating season. He has planted in the bosoms of them all the germ of that love of Nature, which, in all countries and climes, has been so productive of enjoyment, and which lies at the foundation of all the Imaginative Arts. There is often as much true vernal joy felt in the village mead, as in the luxuriant lawns of the opulent.

O let us bless the great Creator, who has scattered so much beauty and delightful variety over his works, and has given to all the power of enjoying them; who has put so much happiness within the reach of poverty itself; and has decked forth a world, that even sin is not allowed wholly to mar or destroy! J. D.

THIRTEENTH WEEK—WEDNESDAY.

THE WOODS.

WINTER has now finally retreated northwards, and left the reviving land to the mild influences of spring. The last spots of snow, the skirts of his cold robe, are dissolving upon the mountain's breast; the air is daily becoming warmer, the sky more serene; and soon will field, forest, and garden be arrayed in their ample summer garments. The sun now, in the course of his daily journey, often shines with full splendour upon the joyful scenery of earth and ocean, and is often veiled by the passing cloud, that casts its silvery rain upon the

fields. Mountain and plain are chequered with flying shade and sunshine, and beautified with golden gleams and fragments of broken rainbows. The young blades, leaves, and flowers, are no sooner thickly strewn with glittering drops of rain, than they are dried by the sunny breeze, and yield to it their sweetest odours. Then every plant is in motion, gracefully waving its shoots or boughs, as if in token of gladness at the vital impulses of the season.

How pleasant, at this time, a rambling walk in the woods! not along the beaten gravel-path, formed by the art of man, but among the wild untrodden copses, the inner forest shrines, where the spontaneous vegetation of nature is least interfered with, where the sweetest birds sing, and the wildest flowerets blow, undisturbed and unseen, in the solitude of the sequestered sylvan shades. There, on every side, unobserved by the common eye, works a life-giving energy, that now clothes the stately tree, the stunted underwood, and the grass and flowers beneath, with the freshest beauty and bloom. There, all the trees are bursting into luxuriant foliage; and the leafy skreen, spread around and overhead, is daily becoming darker and more impervious. The oak is already clothed in a tender and yellowish-green, and is gradually assuming a darker verdure; the beech throws on high its bright green rustling canopy; near it the fragrant birch hangs its pensile branches, reclothed by the breath of spring; and the large buds of the plane are now expanded into glossy leaves. As for the ash, it lingers behind its brethren of the forest; but the willow, the alder, the hazel, and the birch, are already clad in their vernal robes, and lead the way among the sylvan throng.

The eye is pleased with the varied beauty of the living and breathing vegetation around; every thing wears the freshness of youth—the liveliness of a new-born verdure. Even the moss upon the venerable trunk is scarcely noticed amidst the foliage of the over-arching boughs, and the vigorous encircling shoots. The sward beneath the feet, manured with the fallen leaves of a past season, is again clothed with a rank herbage, from which the moisture never exhales. Along the

steep and grassy bank, or under the dewy hazel shade, blooms in virgin beauty that lovely wilding of nature, that earliest woodland flower, the primrose. The grass is besprinkled with its yellow blossoms, which of all others chiefly recall the feelings and sports of youthful days, when, to wander through the woods, and pluck the primrose gay, formed unutterable enjoyment. The thickets of hazel and sloe-bushes, of late so naked as to expose to view the nests of a former year, which they once effectually concealed, are now darkened with buds and leaves, and are alive once more with the brisk labours of birds, and echoing with their song. If we turn to the neighbouring holly, we descry on one of its boughs the blackbird's comfortable nest, where she, with brooding instinct, already hatches her eggs; her mate meanwhile, from some adjacent bough, pouring forth, at intervals, his shrill and beautiful song. And yonder, in the young spruce-fir, whose mossy and evergreen branches afford a warm shelter, is the early nest of the thrush, firmly compacted of moss and withered straws, and plastered inside to keep out the cold night winds. The redbreast hovers about his lowly dwelling, in the decayed dike, or natural bank; and the wren, one of the tiniest, but not least skilful of architects, is seen flying with a bit of moss for the roof of her snug dwelling. And hark! the most soothing and truly sylvan of all sounds, the cooing of the wood-pigeon, issues from 'the aërial elm,' or wide-spreading beech.

'Over her own sweet voice the stock-dove broods.'

The pheasant springs up at our feet, and flies whirring away to the covert of the lonely brake, where he is seldom disturbed even by the approach of the forester. He is a bird of most splendid plume; but, all unlike his gaudy rival the peacock, he avoids the gaze of man, and frequents the unapproached recesses of the woods. Beautifully has the poet said of him,

'He, Christian-like, retreats with modest mien,
To the close copse, or far sequestered green,
And shines without desiring to be seen.'

COWPER.

The woodland brook, lately a boisterous torrent, has shrunk into its well-worn shelvy channel, and now shoots with a softened sound down the steep ravine, and, with a clearer wave and softer murmur, winds along the meadow glade, watering the twisted and exposed roots of the alders and willows on its brink, and reflecting, with every staggering glimpse of sunshine, the wild beauties of the sylvan landscape. Its winter flood-marks, consisting of boughs, leaves, and withered grass, all matted together, are still visible at some distance on each bank, and on the overhanging branches of the neighbouring shrubs and trees. Tracing upwards its wild and devious course, we come to many little rapids and cascades, and behold with admiration the miniature falls that fill the thickets with their din, and fling a gentle spray upon the water-loving shrubs that bend over them. Fancy delights to find, in the tiny and unknown stream, all the features of the mighty river. There are to be seen little shoals, and sand-banks, and shallows, deep pools and foaming cataracts —waters that at one time flow dallying along in many a winding and woody sweep, at another rush impetuously forward in a rapid and arrowy stream. Extend the course of this insignificant brook, we inwardly exclaim, and feed it as it wanders, and it will become a vast inland flood, spanned by lofty bridges, and traversed by ships from every shore ;—the Nile and the Amazon, in the first part of their course, have a channel no larger than the bed of this nameless stream.

As we approach, in our devious wandering, the interior recesses of the forest, where the path becomes rougher and wilder, the trees more lofty, and the brushwood beneath more tangled and untrimmed—where the silence is unbroken by any sound of rustic labour, or noises of flocks and herds that pasture in the open fields, and where the umbrageous vistas are darker and cooler than in the outer woodlands, a solemn reverential feeling steals upon the mind; we give way to sylvan dreams and tender reveries, gently oppressed by the very vividness of our perceptions; and we hold communion, as it were, with the stately vegetable forms around us, sym-

pathizing in their apparent joy in the process of reanimation, hearing in the murmur of the wind among their leaves an expression of delight, and breathing, in the balmy gale, the offered incense of their gratitude. We feel as if placed in a natural sanctuary, in deep seclusion from the tumult of the world. The sylvan gloom is favourable to imaginative meditation. Let us not devote it to the Pan or Sylvanus of antiquity, or to some imaginary Genius of the place, but to the great Creator of all things, whose praise ascends alike from the mountain's lofty peak, from the quiet bosom of the valley, and from the awful depths of solitary forests.

On emerging from the dark and 'leafy labyrinth,' where we have been wandering pleasingly bewildered, our ears are greeted with a multitude of cheerful rural sounds—the lowing of cattle, the bleating of sheep, the cawing of rooks hovering over their conspicuous basket dwellings in the village grove, and all the noises attendant on the field labours of the farmer; and our eyes wander with sudden delight over a wide expanse of clear and yet variegated country—green lea-fields, ploughed lands, watery meadows, banks tufted with trees and coppices, and hill-sides over-run with blossomed furze and broom. We have left a wilderness behind us, and enter upon the bright domain of cultivation, like one who, long enchanted among the dark and thorny mazes of error, is led at last to the illumined region of celestial truth. On returning homewards, let us not forget Him to whom we owe the ever-varying and ever-pleasing aspects of Nature; but consecrate to His praise the feelings and imaginings inspired by our desultory walk. Let us not have entered in vain the solemn temple of the woods.

J. D.

THIRTEENTH WEEK—THURSDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—THE POWER AND INTELLIGENCE OF THE CREATOR.

In looking back on the subject which has been under our consideration, in the course of this volume, it is impossible not to be struck with the force of the cumulative argument, which a view of the reproductive operations of Spring affords, for the being and perfections of God. Every distinct instance of that contrivance, by which, amidst the universal law of decay, the species is preserved, is a separate proof of Designing Intelligence; and, when all these evidences are combined, and made to bear on each other, they form a chain of demonstration, which is not only complete and irresistible, but might even appear cumbrous by its superfluity, did we not discover, in every new example, some new grace and beauty, to interest the mind, and fill it with devout admiration.

In our temperate climate, the gradual progress of returning warmth, with its various accompaniments of increasing light, of subsiding storms, and of genial showers, is attended, as we have seen, with a corresponding development of plants, obviously suited, with studied intention, to the nature of that progress, and the respective grades of temperature in the various latitudes and local peculiarities. These plants, again, are admirably fitted to the condition of living creatures, in all their varieties, from the microscopic insect up to man. The tender stalk shoots, the green blade expands, the flower opens in its beauty, and exhales its perfume, the grain and the fruit grow and ripen, not idly to waste their vegetative powers, but to afford subsistence and enjoyment to those higher species of organized beings, with which they are associated: And, as Nature becomes more and more liberal of her vegetable stores, in the same proportion do the inhabitants of the animal world increase, to partake of the bountiful feast she spreads.

It is well worthy of remark, as an instance of those wonderful adaptations, which I have so often had occasion to notice, that the reproductive season of the vegetable creation is also that of the animal creation. When the various tribes, which have passed the winter in their embryo form, or have survived it in a state of insensibility, begin to move on the surface of the earth, they find a sweet and nutritious food newly created, as it were, for their use, varying in its kind, according to the wants of the animals destined to feed upon it. And the same thing may be said with regard to the young of those living creatures which reproduce their species at this season. The means of subsistence and of enjoyment are amply furnished both for themselves and their offspring, whether, during winter, they have been dormant in holes and caves, or have found scanty support in the half decayed herbage, or have preyed on other animals, or have plied their way from distant lands on unwearied wings.

The instincts, which so irresistibly and intelligently, and yet,—as far as regards the animal itself,—so blindly, impel almost all classes of the lower animals, at this season, to become parents, is another provision which we have noticed as a proof of beneficent design. There is no particular relating to these instincts which is not calculated to call forth the admiration and astonishment of the reflecting mind ; but, above all, the long-protracted cares and incessant toils of the feathered tribes, cannot be contemplated without a peculiar interest. That a world doomed to mortality should continue to be peopled with living beings, indicates prospective contrivance of vast magnitude and extent. The various relations and adjustments, which such a scheme implies, are such, that the bare contemplation of them overwhelms the human mind. Yet how admirably has the provision been made! With what consummate skill and forethought has every thing relating to this complicated subject been urged forward, balanced, and controlled, so that one species of the numerous tribes which teem on the earth, does not press so hard upon another, as to occasion its destruction, and yet the whole globe

is always peopled up to its resources! Into the details of the processes by which this remarkable balance has been effected and secured, I have elsewhere entered, at sufficient length, I think, to show that the more deeply the subject is considered, the more clearly the perfections of the Creator will be unfolded.

The principles on which agricultural labour depends, have also been adduced, as affording another example of beneficent contrivance, which exhibits a remarkable adjustment between the faculties of man and the powers of vegetation. That it should be reserved to man, the only rational being on the globe, by his own judicious efforts, to alter the natural balance of organized existences, so as to give scope for the more extended propagation and the increased comfort of this highest species, is itself a remarkable provision; and that these very efforts should be the means of calling forth and invigorating his faculties, both bodily and mental, and of pressing him forward in a career of improvement, of which it is impossible to foresee the termination, is a view which tends inexpressibly to elevate our conceptions of the Creator, while it causes our hearts to overflow with gratitude for the parental care which he exercises over us.

This retrospective glance over the ground we have traversed, must recall to the mind of the intelligent reader a thousand minute particulars, which, when presented to him in the course of our inquiry, struck him with irresistible force, as indications of a Divine hand. Let him now consider all these particulars, as combining to form one accumulated argument in favour of the existence and attributes of the Creator; and then let him say what he thinks of the strength of that argument. I do not ask if it be possible, by dint of a perverse ingenuity, to elude its force, or, in consequence of a depraved heart, to oppose its legitimate influence on the conduct; for I am well aware, that there is nothing too absurd for the one, or too wicked for the other;—but I ask, whether any candid mind, weighing the evidence with the calm and unbiassed feelings of a philosophical inquirer after truth, can hesitate

for a moment to admit that this evidence is complete and overflowing; and that, for a man, with these facts before him, to doubt of the being of an Almighty and Intelligent Creator, would not be a less decided mark of aberration of intellect, than to doubt of his own personal identity.

THIRTEENTH WEEK—FRIDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—THE GOODNESS OF THE CREATOR.

That God is good, is a deduction of reason from the views unfolded in the preceding papers, not less true and undeniable, than that he exists. His goodness is inferred from his having made pleasure, rather than pain, the stimulus to exertion. Dr. Paley, following Dr. Balguy, who had previously stated the argument in his 'Treatise on the Divine Benevolence,' observes, that the bestowment of certain functions and propensities, necessary to life, are not of themselves proofs of the goodness of God. They may prove the existence of a Being possessed of a high degree of power and intelligence; but then that Being may be malevolent. It may, by possibility, be supposed, that misery, and not happiness, was the object of such a Creator; and we can only with fairness infer his benevolence, when we perceive, further, that the tendency of his creation is to produce a preponderance of happiness.

Paley illustrates this view by instancing the appetite of hunger. A painful feeling of privation was necessary, as we are at present constituted, to create an effective desire for food; but it is all that was necessary, and a Creator not positively benevolent would have been contented with this stimulus. It is a proof of goodness that He has superadded some agreeable sensations to the gratification of the appetite, which were not necessary, and that He has given peculiar tastes and flavours to various kinds of food, that these sensations may be exercised.

The same reasoning applies very extensively to those propensities and instincts which are connected with reproduction. They might all have been invested with an adequate stimulus in a painful craving. It might have been merely to alleviate a constantly burning and never-satisfied appetite, that the feathered tribes, for example, were impelled to the laborious tasks of nest-building, of incubation, and of feeding and rearing their young; indifference, or even aversion, might have been made to attend the union of the parents in the prosecution of these duties; and yet, by means of new and corresponding modifications, the propagation of the species might have proceeded with the same regularity as at present. It is therefore a proof of benevolence in the Creator, that he has not only annexed pleasurable sensations to the parental duties, but has caused the enjoyment far to overbalance the pain. Evidences of the delight attending all these duties, are too obvious to require to be sought for. During the season of reproduction, every ear is saluted with the melodious voice of joy from every field, and wood, and grove. The very sky is made vocal with the enjoyments of wedded love. Look at the swallow, as it twitters from its half-built nest, to ply its laborious task, and say if there is not enjoyment there. Look at the barn-yard fowl as she patiently sits on her eggs, and continues day after day to prolong her monotonous duty, and say if even in this there is not enjoyment. Look especially at the maternal cares which attend the callow brood when hatched, and say again if there is not enjoyment. The whole important process is cheered on by conjugal and parental affection; and wherever there is gratified affection there is happiness.

But the pleasures of Spring are not confined to these exercises. The whole season is a season of enjoyment, increasing and extending towards its close. Sometimes dark clouds may lower, and storms, deforming the face of Nature, may interrupt the flow of pleasure, and even bring destruction and sorrow. But these are exceptions. The general rule is enjoyment. How sweet is the herbage for animals that graze! How tender and succulent the young leaf to the newly

awakened insect! How soft the green carpet which the Creator has spread, at once for food and for repose to the young quadruped! How balmy the air! How genial the mitigated rays of the sun! How smiling the blue sky! How serene the fleecy clouds! How lovely the earth, with its various shades of grateful verdure, and its profusion of flowers!

To man all these things are a source of varied and never-cloying enjoyment. His Creator has endowed him with that mysterious principle of taste, which philosophers have exercised their ingenuity in defining and analyzing, and which, on whatever principles of our nature it may depend, is assuredly an important gift of a bountiful Creator, bestowed expressly for promoting human happiness. In virtue of this gift, all the productions of nature become to him objects of gratification, and all its phases sources of enjoyment. If he turn his eye to the woods, the graceful birch, the venerable oak, the beech, with its wide-spread branches, and its soft green leaves; the poplar, shooting its tall head to the sky; the humble holly, with its glossy foliage, each has its own peculiar charm, and all combined, form one harmonious and interesting whole. If he enter his garden, what a profusion of varied loveliness and sweet perfumes awaits him! Day after day, as the flowers successively expand, some new wonder of creative power and goodness attracts his eye, and gratifies his sense of smell. If he walk abroad in the fields, the rising grain and bursting hedges, in the cultivated grounds, unite with the meadows, the lawns, and the towering mountains, alike to gratify his taste, and to proclaim anew the presence of a beneficent Creator.

Even the sounds which on every side attract his ear, are full of melody. The distant echoing of the woodman's axe and the huntsman's horn, or the mellow note of the thrush, or the soft cooing of the wood-pigeon, or even the barking of a dog, or the cawing of rooks, or the crowing of the domestic cock, is each attended with an agreeable sensation;—while the nearer songs of the little birds, each on its spray, the dew-

drop trembling 'as the minstrel sweetly sings,' are a source of still softer delight; and all these sounds combined, form a chorus of melody grateful to every ear, and filling the heart of the man of refined taste with ecstacy. The sighing of the breeze, the dashing of the mountain cascade, or the gurgling of the rill, as it dances in the sunbeam, and, more perhaps than all, because attended with deeper associations, the hum of busy men, as it ascends, in the gray evening, from the neighbouring village, move the mind to gentle and pleasing musings.

The influence of external nature, in its livelier aspects, upon the feelings, is beautifully described in the 'L'Allegro' of Milton. All the pleasant sights and sounds there collected, and delicately portrayed as the elements of cheerfulness, now enliven the vernal landscape, and fill the eye and ear with 'vernal delight' The following lively images are now felt not to be merely ideal, but derived from the living realities of Nature :—

'To hear the lark begin its flight,
And singing startle the dull night,
From his watch-tower in the skies,
Till the dappled dawn doth rise;
Then to come, in spite of sorrow,
And at my window bid good morrow,
Through the sweet-briar, or the vine,
Or the twisted eglantine;
While the cock, with lively din,
Scatters the rear of darkness thin,
And to the stack, or the barn-door,
Stoutly struts his dames before;
While the ploughman, near at hand,
Whistles o'er the furrowed land,
And the milkmaid singeth blithe,
And the mower wets his scythe,
And every shepherd tells his tale,
Under the hawthorn in the dale.'

This gladness of heart, which the season awakens, has a tendency to produce a beneficial effect on our affections, and to call them forth more tenderly towards our fellow-creatures,

—a sentiment which is thus beautifully expressed by Dr. Seed: —'We are affected with delightful sensations, when we see the inanimate part of the creation,—the meadows, flowers, and fields, in a flourishing state. There must be some rooted melancholy at the heart, when all Nature appears smiling about us, to hinder us from corresponding with the rest of the creation, and joining in the universal chorus of joy. But if meadows and trees in their cheerful verdure—if flowers in their bloom, and all the vegetable parts of the creation, in their most advantageous dress, can inspire gladness in the heart and drive away all sadness but despair, to see the rational creation happy and flourishing, ought to give us a pleasure as much superior as the latter is to the former in the scale of beings. But the pleasure is still heightened, if we ourselves have been instrumental in contributing to the happiness of our fellow-creatures,—if we have helped to raise a heart drooping beneath the weight of grief, and revived that barren and dry land, where no water is, with refreshing showers of love and kindness.'

THIRTEENTH WEEK—SATURDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—THE USE AND DEFICIENCY OF NATURAL RELIGION.

When we say that the Creator is benevolent, we only assert what Nature declares; but Nature qualifies the declaration; for the proof derived from this source is not absolute but relative. She does not display to us a world of unclouded glory and uninterrupted enjoyment, but merely a glory and enjoyment bursting from the darkness of night, triumphing over the gloom of suffering, and gilding and brightening the very clouds which envelope them. The question is, not whether the happiness of the animated world be complete, but whether it be preponderant. Evil is allowed to exist,—alas! this cannot be denied,—but then it is counterbalanced

by good,—nay, the very evil itself changes its nature in various instances, and under the beneficent operation of an overruling Providence, becomes good.

All this is demonstrable in every department of Nature, and in the course of the preceding discussions *has been* demonstrated. Yet, such a conclusion is but partially satisfactory; and, were we bound down to the deductions of Natural Religion, we should find it hard to elude the argument of those who press on us a belief in a God of only limited goodness, or limited power and intelligence. Our feelings would, indeed, revolt from a belief so wretched, and we should have good cause to suspect the soundness of reasoning which could enable the creature thus to sit in judgment on the Creator, and find him wanting. Still, I know not how the inductive reasoning of the Baconian philosophy could be applied, without landing us in this unhappy dilemma; and all that would remain for us would be to wonder at our own temerity, and tremblingly to say, 'Nay, but O man, who art thou that repliest against God?'

This, however, though it may silence, can never satisfy, the inquiring mind; and we are brought back again to a higher theology, and forced to look for the solution of our doubts where alone it is to be found,—in the revealed word of God. We have elsewhere frequently adverted to this difficulty,* and indeed are desirous that the reader should never lose sight of it. That we live in a world of alternate pleasure and pain, is what we see, and feel, and know; that this state was induced by the rebellion of man against his Creator, is what revelation alone unfolds. It is, however, the only way by which a just view of the relations and condition of the external world can be explained. If it be asked why man is but partially happy, the answer is, because he is sinful; and if it be asked again, why the lower animals are but partially happy, the answer still is, because man is sinful. God has, for the discipline of fallen man, smitten the earth with a curse.

The more we interrogate Nature, the more powerfully shall

* See the introductory chapters of the volume on 'Winter,' &c.

we be forced back on the oracles of revealed truth ; and it is on this very account that the interrogation is especially useful. We thus learn at once, the reality and extent of that curse with which she has been smitten ; and we learn also the limits of that knowledge of the Creator which she is capable of unfolding. She tells that there is a God, and affords us some insight into His natural and moral attributes. But she stops short at the very threshold of those discoveries which are most interesting to man,—I mean such as refer to the relation in which he, a sinner, stands to the holy God. There is a fine passage on this subject, in the concluding chapter of Dr. Chalmers' Bridgewater Treatise, with which I have pleasure in closing this volume, as it corresponds entirely with the views I have been inculcating, and expresses, in eloquent language, the conclusion to which I am desirous of leading the reader's mind :—

'Many there are who would gloss over the difficulties of the question, and who, in the midst of all that undoubted outrage which has been inflicted by sinful creatures on the truth, and the holiness, and the justice of God, would, by merging all the attributes of the Divinity into a placid and undistinguishing tenderness, still keep their resolute hold of heaven, as at least the splendid imagination, by which to irradiate the destinies of our species. It is thus that an airy unsupported romance has been held forth as the vehicle on which to embark all the hopes and hazards of eternity. We would not disguise the meagreness of such a system. We would not deliver the lessons of natural theology, without telling at the same time of its limits. We abjure the cruelty of that sentimentalism, which, to hush the alarms of guilty man, would rob the Deity of his perfections, and stamp a degrading mockery on his law. When expounding the arguments of natural theology, along with the doctrines which it dimly shadows forth, we must speak of the difficulties which itself suggests, but which it cannot dispose of ; we must make mention of the obscurities into which it runs, but which it is unable to dissipate,—of its unresolved doubts,—of the mysteries through

which it vainly tries to grope its uncertain way,—of its weary and fruitless efforts,—of its unutterable longings. And should, on the one hand, the speculations of human ingenuity, and, on the other, the certainties of a well-accredited Revelation, come forth to illuminate this scene of darkness, we must not so idolize the light, or the sufficiency of Nature, as to turn from the firmament's meridian blaze, that we might witness and admire the tiny lustre of the glow-worm.

'The two positions are perfectly reconcileable,—first, of the insufficiency of natural religion; and, secondly, of the great actual importance of it. It is the wise and profound saying of D'Alembert,—that "man has too little sagacity to resolve an infinity of questions, which he has yet sagacity enough to make." Now, this marks the degree in which natural theology is sagacious,—being able, from its own resources, to construct a number of cases, which, at the same time, it is not able to reduce. This must be handed up, for solution, to a higher calculus; and thus it is, that the theology of Nature and of the schools, the theology of the ethical class,—though most unsatisfactory when treated as a terminating science,—is most important, and the germ of developments, at once precious and delightful, when treated as a rudimental one. It is a science not so much of dicta as desiderata; and from the way in which these are met by the counterpart doctrines of the Gospel, the light of a powerful and most pleasing evidence is struck out by the comparison between them. It is that species of evidence which arises from the adaptation of a mould to its counterpart form; for there is precisely this sort of fitting, in the adjustment which obtains between the questions of the natural, and the responses of the supernatural, theology. For the problem which natural theology cannot resolve, the precise difficulty which it is wholly unable to meet or to overcome, is the restoration of sinners to acceptance and favour with a God of justice. All the resources and expedients of natural theology, are incompetent for this solution,—it being, in fact, the great desideratum which it cannot satisfy. Still it performs an important part, in making us sensible of

the desideratum. It makes known to us our sin, but it cannot make known to us our salvation. Let us not overlook the importance of that which it does, in its utter helplessness as to that which it does not. It puts the question, though it cannot answer the question; and no where so much as at this turning point, are both the uses and defects of natural theology so conspicuously blended.'*

* Chalmers' Bridgewater Treatise, vol. ii. pp. 286–289.

THE END.

SACRED PHILOSOPHY

OF THE

SEASONS;

ILLUSTRATING

THE PERFECTIONS OF GOD,

IN THE

PHENOMENA OF THE YEAR

BY THE

REV. HENRY DUNCAN, D.D.,

RUTHWELL.

SUMMER.

Thou crownest the year with thy goodness, and thy paths drop fatness. They drop upon the pastures of the wilderness; and the little hills rejoice on every side. The pastures are clothed with flocks; the valleys also are covered with corn. They shout for joy; they also sing.'—PSALM LXV.

NEW YORK:

ROBERT CARTER & BROTHERS,

No. 530 BROADWAY.

1856.

'Thou art, O God, the life and light
Of all this wondrous world we see;—
Its glow by day, its smile by night,
Are but reflections caught from thee!
Where'er we turn, thy glories shine,
And all things fair and bright are thine.

* * * *

'When youthful spring around us breathes,
Thy Spirit warms her fragrant sigh,
And every flower the summer wreathes,
Is born beneath that kindling eye:—
Where'er we turn, thy glories shine,
And all things fair and bright are thine.'

MOORE.

ADVERTISEMENT.

In this Volume, the argument for the Divine perfections from the works of Nature, entered upon in the two preceding volumes of 'Winter' and 'Spring,' is continued. Organized life has now passed, or is rapidly passing, from a state of development to a state of perfection; and, Winter having been considered as the period of gestation, and Spring as that of production, Summer is here viewed as the season of maturity. This is not, indeed, strictly true; for many of our fruits, and all the cereal plants, are, in our climate, still only in progress, and do not ripen till the autumnal months; while numbers of the animal tribes are, at present, but in the early stage of their existence;—and, in this respect, to man all seasons are alike. It is, however, the general character of the season that is to be considered; and classification is more important, in a work of this kind, than a strict attention to dates.

In this, as in the other volumes, I have commenced with a view of the various cosmical arrangements by which the season is distinguished and rendered salutary, and have thence passed to the consideration of vegetable life; and thence again to that of the various pow-

ers and functions of animal life,—keeping always in view the reference which every thing evidently bears to the only rational being whom it has pleased the Eternal to place in this lower world, or, at all events, to subject to the operation of the senses.

The Volume next contains some notices of Man himself, in reference to his physical, intellectual, and moral powers; and closes with a summary of the argument which this analysis of Nature has exhibited, with special attention to the peculiar modifications of that system of providential administration, under which the Fall of our First Parents has placed terrestrial things.

In thus ranging through the whole bounds of creation, where the materials are so unlimited in their extent and variety, I have ever found it much more difficult to determine what might without prejudice to the argument be rejected, than what might be usefully chosen. All Nature, in its various kingdoms, in all its orders, in all its species, in every individual modification, proclaims the perfections of the Creator. In such superabundance, however, I have had the advantage of easily avoiding what was abstruse and recondite; while my object has been to select what was most interesting and most easily understood, as well as important, striking, and conclusive.

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SACRED PHILOSOPHY OF THE SEASONS.

SUMMER.

FIRST WEEK—SUNDAY.

SUMMER THE PERFECTION OF THE YEAR.

Summer is the manhood of the year. Its powers are developed; its vigour is fresh; its plans are matured; it is in the full flush of beauty, and buoyant with the joy and bustle of existence. Turn where we will, there are proofs of operations begun and in progress, which indicate design, wisdom, and activity; of a past infancy and youth spent in preparation, and ending in settled purposes reduced to practice, and useful employments industriously prosecuted.

Such is the general character of this season; and when we take a more accurate survey of particulars, a thousand delightful illustrations occur, all leading us to the same sublime conclusion, that the natural operations which are silently proceeding around us, are the work of a present Deity, and a reflection of his attributes. In the sacred poetry of the Hebrews, we meet with many solemn and beautiful views, which show how much alive the inspired writers were to such impressions. The hundred and fourth Psalm is an example of this; and a few passages from that majestic production may serve as an illustration. 'He watereth the hills from his chambers, the earth is satisfied with the fruit of thy works. He causeth the grass to grow for the cattle, and herb for the service of man, that he may bring food out of the earth; and wine that maketh glad the heart of man; and oil to make his face to shine;

and bread which strengtheneth man's heart. He appointeth the moon for seasons; the sun knoweth his going down. Thou makest darkness, and it is night; wherein all the beasts of the forest do creep forth. The young lions roar for their prey, and seek their meat from God. The sun ariseth, they gather themselves together, and lay themselves down in their dens. Man goeth forth unto his work, and to his labour, until the evening. These all wait upon thee, that thou mayest give them their meat in due season. That thou givest them they gather. Thou openest thine hand, they are filled with good: Thou hidest thy face, they are troubled: Thou takest away their breath, they die, and return to their dust: Thou sendest forth thy spirit, they are created; and thou renewest the face of the earth. The glory of the Lord shall endure for ever. The Lord shall rejoice in his works.'

To such reflections the pious mind is naturally led, in casting an eye over the luxuriant scenery which this season presents, and contemplating the various tribes of animated beings, for whose use such a profusion of bounties is scattered abroad. It requires no philosopher, deep-read in the mysteries of nature, to inform us that there is a profound and beautiful adjustment among all the departments of nature, in which the hand of an intelligent Creator is distinctly seen. The earth, the sea, the air, and the blue vault of heaven, with its orbs of light, all speak the same language. There is a harmony and an adaptation among these mighty elements, which strike the mind at first sight, and which are exhibited more clearly by every subsequent inquiry. Were any one of them either wanting, or even materially altered, the system would be destroyed. And while they harmonize among themselves, they are peculiarly distinguished by their adaptation to the support of organized existences. Without the sun, the earth would be a dark and useless mass; without the sea, there would be no moisture to support organic life; without the air, there would be no machinery for conveying that moisture to water the soil; without any one of these there would be no vegetation,—no animals,—nothing but desolation, silence, and death. That

these inorganic powers might exist independent of an intelligent Cause, may be admitted, although any reasoning which should demand such a concession, could only be founded on an appeal to our ignorance; but that they should exist in such proportions and combinations as to produce the phenomena of nature, may be safely pronounced impossible.

It is now our peculiar business, however, to consider these matters only in so far as they relate to the present season of the year. The contrivances connected with Winter and Spring, have already been traced; and, in considering them, we have had occasion continually to exclaim, in the language of the psalm from which we have quoted:—'O Lord, how manifold are thy works! In wisdom hast thou made them all; the earth is full of thy riches.' The very same character will be found impressed, with equal distinctness, on the appearances and operations of Summer.

There is a pleasure peculiar to Spring in the contemplation of Nature rising, as it were, from the tomb, and bursting into life, and light, and joy; but that which belongs to Summer is not less intense, although of a different kind. The delight of this season arises from the view of the full development or successful progress of the powers and processes which in Spring began to operate. The plants, which had just pierced the earth in the commencement of that season, have now shot forth their stalks, and expanded their blades, and opened their beautiful flowers to the sun; the trees rejoice in their leafy pride; the fields luxuriate in the abundance of their vegetable stores; and animated nature is instinct with life and enjoyment. The whole scene is full of delight; but it is only when it is associated with religious feelings, and when it raises the mind to a Father Being, who called all this loveliness into existence, and whose unseen presence and mysterious energies cheer and bless the world He has made, that it can be enjoyed with its highest and most appropriate relish. It is this pious sentiment which gives such sublime beauty to the 'Hymn on the Seasons;' and perhaps there is no part of that hymn which more successfully expresses the

tenderness and devout admiration of a rightly constituted mind, in contemplating the wonders of Nature, than that which refers to Summer:

> 'Then comes thy beauty in the summer months
> With light and heat refulgent.—Then thy sun
> Shoots full perfection through the swelling year;
> And oft thy voice in dreadful thunder speaks;
> And oft, at dawn, deep noon, or falling eve,
> By brooks and groves, and hollow whispering gales.
>
> * * * * * *
>
> Soft roll your incense, herbs, and fruits, and flowers,
> In mingled clouds to Him, whose sun exalts,
> Whose breath perfumes you, and whose pencil paints.'

There is an analogy between the seasons of nature and the seasons of grace. In the latter, as well as in the former, there is a spring and a summer,—an infancy and a manhood. The first breathings of Divine love on the heart are often faint and fitful. They come like the first breeze of spring, fraught with warmth, and bearing the promise of future fruit, but passing over a dead and barren region, to which they seem unallied and uncongenial. They are generally succeeded by wintry gloom and tempest, which, from contrast and disappointed hope, they render only more dismal. But still gentler breezes breathe, and longer light and a warmer sun shed their genial influences, till the whole soul glows and is renewed, and the germs of a Divine nature, springing into life, reveal the creative power of the Spirit which erewhile moved on the face of the deep, and gave order and beauty to the formless void of the material world. The work proceeds amidst alternate sunshine and showers; the warmth and illumination increase; the virtues and graces grow and expand; what was wavering becomes steady; what was feeble becomes strong; what was sterile, luxuriant; the dark brightens; the deformed is clothed with beauty; where there was deadness, there is animation; where there was taint and corruption, there is health and soundness. The spring is

past, and summer reigns. The Sun of Righteousness shines in all his glory, and the soul is buoyant with spiritual life, and teems with fruit.

Yet this progress, though sure, is slow, and frequently retarded. The sun is not yet without clouds, nor the atmosphere free from storms; a sudden cold may still chill; the thunder may raise its terrible voice; the floods may burst forth and overwhelm. The enemy comes: Tares are sown and grow; thorns spring up, and mildew and blight are in the air. It is, at the best, but an earthly summer, though the vivifying influences come from heaven. The harvest, however, approaches. Then the tares shall be separated from the wheat. The tares shall be burned with unquenchable fire; but the wheat shall be gathered into the garner of God.

FIRST WEEK—MONDAY.

INCREASED HEAT.

Summer may be said to be the season of growth, as Spring is of reproduction. Those organized existences, which burst into life in the latter season, are either brought to maturity, or, at least, invigorated and expanded in the former, and, in both seasons, the peculiar character of the weather is most wisely adapted for the intended object. We have already had occasion to remark the proofs of Creative design and intelligence, which may be drawn from the adjustment that subsists between the inorganic and the organic worlds, in very many and very striking particulars. The state of the atmosphere, during the progress of the summer months, presents itself as an appropriate subject of consideration, in entering on the study of this season.

I have elsewhere stated the general principles of atmospheric phenomena,* but what falls under our notice at present,

* Volume on '*Winter*,' article Atmosphere, &c.; and Volume on '*Spring*,' article Rain, &c.

is the change produced in the weather by the advancing year. The sun is now approaching the northern tropic, having, in the month of March, passed from the south to the north of the equator. He is rising high in the heavens, and thus pouring his rays more directly on this part of the earth, which, according to a principle already explained, causes his influence to be more powerful; and what much adds to this influence, is the greater length of time in which he remains above the horizon. In the depth of winter, we enjoyed his presence little more than seven hours out of the twenty-four. In the beginning of summer, this period is increased to upwards of fifteen hours, and in the middle of it he daily lingers with us two hours longer still. There is thus not only a great direct increase, but a great accumulation of heat. The mode in which this effect is produced, may be shortly mentioned. The rays of the sun, or whatever the influence may be which generates heat in passing through a perfectly transparent medium, do not increase the temperature of that medium. They seem to require resistance to produce this effect. It is not therefore till they reach the earth, that their power is very sensibly exerted. In striking upon the opaque surface of our globe, they give out their qualities. Light and warmth are produced and reflected. The earth and the atmosphere are thus both subjected to their influence. These become heated, the one by conduction, the other by reflection. Now, it is obvious, that while the intensity must be in proportion to the directness with which the globe is struck by the sun's rays, the accumulation must be in proportion to the length of time during which the influence continues. Hence, there is a double cause for the summer's heat, the height to which the luminary rises in the heavens, and the length of the day compared with the night. These causes operate in an increasing ratio. Day after day the accumulated heat receives fresh accessions. Every time the sun's influence is repeated, it penetrates deeper below the surface, and is more intensely reflected into the already heated atmosphere. This effect continues even after the direct solar heat has begun to be diminished; and it is not till

several weeks after the sun has begun to take a retrograde motion, that the temperature is at its maximum. In June, the sun reaches his greatest height, and begins to decline, but the heat continues to increase till the middle or end of July.

But there are various circumstances besides warmth, which constitute summer weather. The mechanism of the atmosphere is very complicated, and the adjustments which it requires are exceedingly nice, and considering merely the nature of the powers employed, we may well add, hazardous. Any change in the relative proportion of one of the principles, is calculated to produce a powerful effect on all the rest, and were there not a regulating power of consummate wisdom, it might be expected that the balance would be overset, and that the most disastrous consequences would ensue. Let us look for a moment at the constituents of the atmosphere, and this will become apparent. The air, which forms the chief part of the atmosphere, is composed of two substances, held together merely by mechanical admixture, which are of very different properties, and which require to continue united in the precise proportion they actually bear to each other, in order to be capable of sustaining animal and vegetable life. Were that proportion destroyed even in a slight degree, the air we breathe would be instantly converted into a deadly poison. Now, it is well worthy of remark, that, although in the functions both of animal and vegetable life, and in the process of combustion, a great and apparently unequal consumption of these two substances takes place, the proportion between them is always maintained, and this notwithstanding any difference of temperature. Heat expands, and cold contracts them, but they are not thus disunited, or in any way disturbed in their proportions. On the contrary, it is probably in some degree owing to the alternations of heat and cold, which keeps up a constant motion in this wonderful fluid, that the necessary balance is maintained.

Another ingredient in the atmosphere is moisture. This is very sensibly acted on by heat. It is the principle of heat

which evaporates the moisture from the earth, and causes it to mix with the air, and to float in it, sometimes as an invisible fluid, sometimes in the form of clouds, and which at other times causes it to be precipitated in the form of rain. Now, the remarkable circumstance is, that although heat is the agent in these operations, the change of temperature does not so affect the process as to cause the operations to cease, or very materially to disturb them. Evaporation goes on both at a low and a high temperature, and in both states clouds are formed and rain falls. This is owing to a very peculiar provision, obviously imposed by consummate wisdom. The air is made capable of containing vapour in a certain proportion to its temperature, and it is not till it be saturated that the evaporation from the surface of water ceases, or that deposition takes place. The temperature of the air in winter does not, indeed, admit of the same quantity being held in solution as in summer, but up to a certain point it is equally capable of sustaining it in the one case as in the other. Evaporation, therefore, takes place in very cold weather, even from ice and snow, and the water thus infused into the air is carried up into the higher regions, till it reaches the point where the temperature is such as to correspond with the quantity of moisture. Precisely the same process takes place in summer, with this difference, that the evaporation is much more abundant, and the air, owing to its increased temperature, is capable of containing a far greater quantity in solution. Again, the point of deposition is regulated by a similar law, with a similar difference. Deposition does not take place either in winter or summer, till the air is more than saturated; but this effect is produced at very different temperatures, according to the quantity actually held in solution, so that a very slight degree of cold will form clouds and cause rain in summer, compared with what is necessary to occasion the same phenomena in winter. Hence the processes of evaporation and deposition are made, by this very peculiar law, always to bear a relation to the actual temperature of the season, and such a balance is kept up between these pro-

cesses, as is admirably suited to the wants of vegetable and animal life.

I may add to all this the properties of the atmosphere, by means of which it is made the vehicle of light and sound, and the means of respiration. The changes which the air undergoes by the operation of heat and cold, might easily be supposed, and might even perhaps, reasoning without the aid of experience, be expected to produce a material alteration on such properties. But although these changes are so considerable in different seasons, and in different climates, we do not find that the laws either of vision or of acoustics, are in any material degree affected by them,—or that the action of the lungs, either in man or the lower animals, is impeded or deranged.

In attending to the complicated nature of the atmosphere, and the various important functions it has to perform, and in considering the diversified modifications it must necessarily undergo by the alteration of its temperature, both in the various latitudes of the globe, and in the different seasons of the year, it does seem impossible to doubt that the uniformity of its properties, and of its salutary influences under all these modifications, has been provided for, by what Whewell, considering that subject in a more extended view, justly calls 'a most refined, far-seeing, and far-ruling contrivance.' So many opposing forces, and the mingling of such subtle and fearfully active elements, appear in the most quiescent state to require amazing prospective skill for their regulation and control; and when we find them, even under the influence of extensive changes, still harmoniously combining their powers for the general good, we cannot but perceive that all this could not be effected but by the same paternal Hand which originally called their powers into action.

FIRST WEEK—TUESDAY.

INTERNAL HEAT OF THE EARTH.*

Besides the phenomena already alluded to, relative to heat, there is another of very extensive operation, which, although it cannot be considered as entering immediately in any perceptible degree into the formation of climate, is yet too remarkable to be passed over without some notice. I allude to the existence of that heat in the interior of our globe, which cannot be referred to external causes, and which has produced, and is continually producing, great and important changes on its surface.†

Indications of the action of a powerful heat in the inner strata of the earth, meet the geologist at every step of his investigation, and it is only by this agency that he is able to account for various existing phenomena at or near the surface, from which, instead of stopping to enumerate them all, I shall select a few of the most striking instances.

Two kinds of springs exist in Nature,—the common, and the thermal or warm. The temperature of the common spring is found to be nearly that of the medium temperature of the

* For several of the facts stated in this paper, I am indebted to a valued friend.

† 'The evidence in proof of great and frequent movements of the land itself, both by protrusion and subsidence, and of the connexion of these movements with the operations of volcanoes, is so various and so strong, derived from so many quarters on the surface of the globe, and every day so much extended by recent inquiry, as almost to demonstrate that these have been the causes by which those great revolutions were effected; and that, although the action of the inward forces which protrude the land has varied greatly in different countries, and at different periods, they are now, and ever have been, incessantly at work in operating present changes, and preparing the way for future alteration in the exterior of the globe.' *Fitton's Geological Sketch:* See also, *Lyell's Geology*, vol. i. *passim.* This author observes, that the subsidence occasioned by volcanic agency, is somewhat greater than the elevation, and that the climate has been much affected indirectly by the changes thus produced in the relative position of sea and land.

locality where it rises; the thermal spring possesses a considerably higher degree of heat. The temperature of the former is derived from the soil heated by the sun;—of the latter, from the warmth of those internal strata, from whence they issue. The thermal springs vary in their temperature from a single degree above the medium of the climate, to the heat of the warm waters of Bath, and the boiling Gysers of Iceland. These springs are to be found in almost every country, and exist to an extent which has not yet been ascertained. Artesian wells are almost universally thermal; and it is a strong proof of the existence of a high temperature in the interior of the earth, that the heat of these wells increases in proportion to the depths at which they take their rise,—a fact which seems to be ascertained on satisfactory evidence. It is also worthy of remark, that thermal springs do not belong exclusively to any particular formation, being found in the latest as well as in the oldest series. They exist below the level of the sea, and at all heights above it, to the extent of 12,000 and even 13,000 feet. They are discovered in all latitudes,—in the neighbourhood of the Polar Regions, as in Iceland and Greenland, equally as in the temperate zone, and under the equator. Their heat cannot, therefore, be sought for in any particular formation of rocks, nor in local chemical processes, but in some cause which is of very extensive operation throughout the interior of the earth.*

In connexion with the fact, that the temperature of Artesian wells indicates the depth of their formation, I have to observe that, in all mines, it has been lately ascertained, that the temperature increases as we descend. The exact proportion of increase for the descent has not yet been very accurately settled; but, by collating the observations already made, it may be safely stated at 1° of heat for every 45 feet of descent.

The last and most decisive proof of the existence of internal heat, is to be found in the volcanic agency which appears

* Bischof.

in every age to have been actively and extensively employed, and so many traces of which have been left in every part of the world. Mr. Lyell informs us, that there are certain very extensive regions, to which both volcanoes and earthquakes seem chiefly to be confined, and which would appear to be connected with immense internal fissures in the crust of the earth, through which the central heat finds its way to the surface. He particularizes the whole region of the Andes, including Mexico and the West Indies, which pursues a course of several thousand miles, from north to south; the region, of at least equal extent, which commences on the north with the Aleutian Isles, and extends first in an easterly direction for nearly 200 geographical miles, and then southward, without interruption, throughout a space of between 60° and 70° degrees of latitude to the Molluccas, where it branches off in different directions;—and, in the Old World, the region extending from the Caspian Sea to the Azores, a distance of about 1000 geographical miles. 'Over the whole of the vast tracks alluded to,' says this author, 'active volcanic vents are distributed at intervals, and most commonly arranged in a linear direction. Throughout the intermediate spaces, there is abundant evidence that the subterranean fire is at work continuously, for the ground is convulsed from time to time with earthquakes; gaseous vapours, especially carbonic acid gas, are disengaged plentifully from the soil; springs often issue at a very high temperature, and their waters are very commonly impregnated with the same mineral matters which are discharged by volcanoes during eruptions.'*

The fact, then, seems to be established, that there is a vast region of excessive heat in the centre of the earth; and that the crust of the globe is rent internally into very extensive fissures, along which that formidable agent approaches nearer the surface, and through which it finds occasional or permanent vents. This, being proved, seems to open to us, not

* Lyell's Geology, vol. i. p. 360, &c.

only one of the natural causes of the previous revolutions on the surface of our planet, but a source of future disruption and ruin. The 'more sure word of prophecy' informs us, that the time will come when the elements shall be dissolved with fervent heat, and the earth, and all that is therein, shall be burned up; and it is satisfactory to observe, that geological indications render this catastrophe not only possible, but probable. Let it only be conceived that the safety-valves, by which the superabundant heat generated internally is at present thrown off, were by some convulsion to be stopped up, or that some other deranging cause were to occur, which should destroy the equilibrium at present subsisting between the great central fire and the shell in which it is enclosed, and an explosion would take place like the bursting of a bomb; or, at all events, a force would be exerted, which might altogether derange the present system of things, and set the world in a blaze. The powers which sustain the great planetary system, are equally balanced, and, notwithstanding the existence of a resisting medium, may, as to all practical results, be considered stable; but it is not so with the materials of our own globe. These have already undergone numerous disruptions; and there is one other catastrophe still in reserve for them. We see the elements of that catastrophe in existing phenomena, and, when we look to the announcements of Scripture, the event, which might almost be anticipated, is authoritatively foretold.

The friend who was so obliging as to furnish several of the above-mentioned facts, takes much laudable pains in the paper he has sent me, to show that the operation of natural causes in no respect precludes the immediate arrangements of the supreme moral Governor, in carrying on the great schemes of his providence; and that, even if it could be proved that the deluge, for example, or the destruction of the Cities of the Plain, was brought about in the natural course of events, these ought still to be regarded as catastrophes determined in the councils of the Most High, to bring signal vengeance on his rebellious creatures, and calculated by him

with consummate wisdom and unerring prescience, to effect a great moral purpose. Nothing can be more true or important than this sentiment. The world of Nature, and the world of Providence, are always in harmony; and the Eternal brings about his decrees usually by the adjustment of general laws to the purposes of his moral government;—and yet He has reserved to himself the power of interfering with those laws when he thinks fit, that by doing what He alone could perform, He might bear undeniable testimony to the mission of his Son, or to those messages which He was from time to time pleased to send by his servants, from the unseen world. In the latter case, the hand of God is discovered by the miraculous nature of the transaction; in the former, by the fulfilment of prophecy. If the destruction of the world by fire, therefore, shall prove to be the result of natural causes, this will not diminish the evidence of Divine agency; for, independent of the miraculous events with which we are assured it will be accompanied, its very coincidence with prophetical intimations will sufficiently evince the source from whence it proceeds.

FIRST WEEK—WEDNESDAY.

INCREASED LIGHT.

It is not merely the increase of heat, but the increase of light, which constitutes the peculiarity of summer weather. The latter property is almost as necessary to organize life as the former, and its abundance at this season produces, doubtless, an important effect both on the vegetable and animal world. In another volume I have alluded to the uses of light in the growth of plants,* and have particularly noticed the power which it possesses of endowing them with smell, colour, and inflammability, as well as the essential function which it exercises in respiration through the leaves, where the prop-

* Spring, pp. 67 and 78.

er juice is secreted. Now, it is obvious that a very important effect must be produced in these particulars, by the degree in which light is communicated to them, both as regards its intensity and its duration. As long as the plant is in the light, the leaf decomposes carbonic acid, appropriating the carbon to the formation of its own proper juice, and returning the disengaged oxygen into the atmosphere. When light is removed, it has no longer power to imbibe carbon and disengage oxygen; but, on the contrary, it gives back some of the carbon already obtained, and absorbs oxygen, for the purpose of reconverting this into carbonic acid. The simple mention of this fact shows in what a different state a plant must be placed with regard to its vegetative action, in consequence of the increased and lengthened light of summer. When the nights are longer than the days, the greater part of its existence is spent in reversing the process by which some of its most important properties are obtained. As the day lengthens, it requires longer time to feed on the light, and spends less in the exhausting, but still, to a certain extent, useful process of depletion.

In the increased light, then, as well as in the increased heat of the summer months, we find a beautiful adaptation to the peculiar properties of vegetable productions. They are now in a state of growth. In their progress towards maturity, they stand peculiarly in need of powerful excitement and healthy nourishment. This, the Creator has provided for them, not merely in the additional warmth, but in the additional brilliancy and lengthened influence of the solar rays. The beneficial effect thus produced will appear, whether we consider the different influence of different seasons in the same country, or compare the vegetation in one climate with that of another. In a gloomy season, when the light of the sun has been much obscured by clouds, this circumstance is not compensated for by the heat of the weather. Vegetable nature puts on a sombre hue, corresponding with the aspect of the atmosphere. All nature seems to droop. The flowers become pale, and hang their heads. Their fragrance and their

beauty decay. The fruits ripen slowly and imperfectly, and their flavour comes not. Herbs, plants, and trees, seem all equally to mourn the absent sun. But let the case be reversed; let the clouds disperse, and the sun shine forth in his strength. Presently all nature regains its loveliness. The colours of the flowers brighten, and their perfume fills the air. The fruit blushes on the trees, and invites the hand of the passer by. The productions of the gardens and the fields are invigorated, and their peculiar properties are heightened and improved. Every thing seems to revive and to rejoice in the genial beam.

The powerful effect of light is not less obvious within the tropics, and in countries bordering on these regions. There the beauty and fragrant scent of the flowers increase in proportion to the brilliancy and clearness of the atmosphere; the taste of edible substances becomes more racy and pungent; and the vegetable produce increases in variety and usefulness. It is on the properties of light, more than on those of heat, that these differences depend, as has been proved by direct experiment.

Here, then, we have a new proof of beneficent contrivance. The source of heat is also the source of light. These two qualities, though differing from each other in essential properties, are yet combined in the sun, and constantly accompany each other by means of this combination, in all the arrangements which constitute weather, becoming more or less intense in relative proportions. We are so accustomed to find light and heat in combination, that it seems to be a kind of violence done to our judgment, to consider them as disunited. They are probably, indeed, properties of the same substance, although one set of these properties is sometimes quiescent, as we have elsewhere observed,* while the other is in a state of activity. Let us suppose that they always appeared separately; that the sun, for example, was the source of heat, and the moon the source of light. The earth would still be cheered, every twenty-four hours, with the presence of both of these

* See 'Winter,' articles on Ignis Fatuus, Phosphorescence, &c.

essentia' qualities, but without correspondence, and without co-operation. The moment that they ceased to coincide, they would cease to be useful. The whole system of the weather, and along with it, of organized matter, would be deranged; vegetable life would cease to be reproduced; and this being the case, animal life would necessarily perish. A much smaller alteration than this, indeed, would produce nearly a similar effect. Suppose that the law were, that light and heat should give out their influence in an inverse, instead of a direct ratio, —that the light was greatest when the heat was most diminished. We should thus have brilliant but cold suns in winter, and warmth but gloom in summer. The consequences of such an arrangement it might be difficult to trace in all its effects on the complicated machinery of the atmosphere; but that it would be altogether unsalutary, is easy to perceive. The heat of summer might be sufficient to cherish a pale and feeble vegetation, but the plants would be destitute of a vigorous fibre, the flowers would but languidly expand their petals, and the seeds would not ripen. In a few years, on the supposition of the constitution of plants remaining the same as at present, the powers of reproduction in most of the vegetable kingdoms would cease, and the soil would be left in possession of the few unimportant plants which now flourish in the shade.

There appears to be nothing in the nature of things to render such an arrangement impossible. How comes it, then, that light and heat increase and diminish in the same ratio, or, indeed, that they are combined at all? Or, granting that there is a natural necessity for this combination, how comes it that plants have received such a constitution that the increase of light is as necessary to their perfection as the increase of heat? Only one answer can be given to this question. It is the arrangement of an Intelligent Being. Chance is excluded. The law which connects vegetable life with the actual state of light and heat, must have been imposed by a wise and benevolent Creator.

If it be objected, that I have been speaking only of the properties of the sun in temperate regions, and that between

the tropics a different law prevails; I answer, the arrangement is, in some respects, different, but not opposite. There is a smaller range in the alternations of heat and cold, of brightness and gloom, of night and day; and let it be remarked, that both vegetables and animals are singularly adapted to this peculiar condition. Organized existences are created with properties suitable to the state of the tropical weather, just as others are created for existing and flourishing under the arrangements of a temperate climate: And this, in fact, singularly strengthens our argument. How does it happen that tropical plants possess these properties? It is not from an inherent principle of accommodation to circumstances; for plants possess the property of acclimation, as it is called, only within a very narrow range. Change the arrangement with what caution you may, and the experiment will not succeed. Convey the tropical vegetation to the temperate zone, and that of the temperate zone to the tropics, and no favourable circumstances can prevent them from becoming extinct, when left to the natural agency of the climate. Can this be the effect of chance? Can it be mere accident, that the one set of existences is suited to the one set of conditions, and the other to the other? The reply may be safely left to the common sense of the reader; and here again we have a new subject of devout admiration.

FIRST WEEK—THURSDAY.

ELECTRICITY.

The principle of electricity has been already mentioned as residing in the atmosphere; and as it frequently displays its tremendous powers during the summer months in the thunder stroke, it seems to demand some notice, although its properties have been more distinctly ascertained than its uses. The truth is, that notwithstanding the attention of philosophers has been very assiduously turned to this subject of late years,

especially since the discoveries of Franklin and Galvani, and many very singular facts have been established in regard to this remarkable agent, there is still so much obscurity attached to the whole subject, that, in the present state of the science, nothing very precise can be stated as to the important functions which it doubtless exercises in the economy of nature.

That electricity extensively pervades the fluid which surrounds our globe is certain; and it is not less distinctly ascertained that it performs a powerful part in influencing and modifying the changes which take place in the weather, both as relates to warmth and to moisture; but its substance is too subtle, and the laws by which it acts are too singular, to enable us, in the present state of our knowledge, to decide either as to the exact nature or the full extent of its operations. That it is extensively employed in the various modifications which the clouds undergo, may well be believed, since it has been ascertained, by means of Franklin's electric kite, that clouds are sometimes negatively and sometimes positively electrified; and, indeed, the copious falls of rain consequent on a thunder-storm, are themselves a sufficient proof of this influence. It has been supposed, that it is the electric power which preserves moisture in the form of mist or cloud while floating in a state of deposition,* and that when this influence is withdrawn, it necessarily falls in the form of rain. If this be the case, as is probable, an agency is assigned to the principle which is both extensive and highly important. Were rain always to be the consequence of the deposition of moisture in the atmosphere, a totally different, and certainly a less salutary, result would be produced. There would be no clouds, and the showers would fall almost without warning,—suddenly, violently, and frequently. It is probable, too, that rain would fall more partially and unequally than is the case at present, when clouds, once formed, are borne in all directions on the wings of the wind. At all events, we know,

* It has just been accidentally ascertained, that the electric fluid is abundantly contained in the steam generated in the boiler of the steam-engine.—Fourth Edition, 1841.

that the present means, whatever they may be, by which the distribution of moisture on the surface of the earth takes place, is most skilfully adapted to the purposes of organic life.

Another property which has been said to belong to the principle of electricity, is the assistance which it affords to the processes of vegetation. While these processes proceed, it is ascertained by some late experiments, that there is a constant circulation of this fluid, if it deserves that name, between plants and the atmosphere, and there is, therefore, reason to believe, that this circulation is essential to the growth and health of the former. Various contradictory experiments, however, have been made on this subject, producing conflicting theories, and not ending in any very satisfactory result. The Abbé Nollet and the Abbé Bertholon, both made experiments, which seemed to prove that the artificial application of electricity considerably accelerated the vegetable process, and rendered it more vigorous; and the latter took so strong a view of this subject, that he seriously proposed the erection of what he named *electro-vegetometers*, or thunder rods, for bringing down the electricity of the atmosphere to the earth, for the purpose of fertilizing the soil. After describing his plans, he thus expresses himself:—'By these means we shall have an excellent vegetable manure, or nourishment, brought down, as it were, from heaven, and that, too, at so easy an expense; for, after the construction of this instrument, it will cost nothing to maintain it: it will be, moreover, the most efficacious you can employ; no other substance being so active, penetrating, or conducive to the germination, growth, multiplication, or reproduction of vegetables.' The Abbé's views, however, appear to be visionary; and the experience of several other philosophers are far from confirming the effects above mentioned; so that nothing more can be positively affirmed, from actual experiment, than the existence of a circulation of electricity in plants during vegetation. Further experiments are required to elucidate this very interesting subject.

It is now generally understood, that the phenomena of electricity depend on the existence of two fluids of different but corresponding qualities. Into this subject it scarcely lies within my province to enter; and all that is needful to be noticed is, that there is a negative and a positive electricity, each possessing peculiar laws, by whatever theory these laws may be accounted for. These agents, or properties, give rise to the remarkable natural phenomenon of thunder. This has been ascertained abundantly by direct experiment; and it may be held as proved, that the explosion takes place in consequence of a communication between two substances, of which the one is positively and the other negatively electrified. This chiefly happens in certain conditions of the clouds, when the equilibrium of the atmosphere has been disturbed. When different currents of air bring into contact two clouds differently electrified, the consequence is, that a sudden interchange of the electric principles takes place, which gives rise at once to the thunder-clap and the flash: a similar effect is produced by the electric or non-electric state of the earth, when the atmosphere is in an opposite state. The lightning in this case, does not flash from cloud to cloud, but descends in a thunder bolt to the earth, or issues from it in the form of a brilliant flame. Under any of these circumstances thunder is produced, but it is only when the interchange is with the ground that there is danger of fatal consequences to organized existences. There is another form which the electric matter frequently assumes in the fine evenings of summer. It is called sheet-lightning, and bursts generally from behind a dark cloud near the horizon, in a broad and vivid flash, never accompanied with the sound of an explosion. In all these instances the intention is, that the atmosphere shall be restored to a salubrious state, by carrying the fluid from places which are over-charged, to others which are deficient.

Although we do not know the precise relations between electricity and the other elements which constitute the atmosphere, yet, so far as we can penetrate, these relations are highly salutary, and those who best know the properties of

each, will be most ready to acknowledge, that there must be some wise and wonderful adjustment,—some mysterious but most necessary regulating principle, by which the one has been rendered compatible with the useful operation of all the rest. With regard to thunder in particular, the effects of which are sometimes so tremendous, it is useful to remember, that this striking phenomenon is the result of an effort of nature to recover itself, and restore the equilibrium of its constitution, and may therefore be compared to the crisis of a fever, and various other indications of the *vis medicatrix* in the animal frame. It is awful but beneficial. 'The deep lowering gloom of the thunder-cloud,' says Mr. Whewell, 'the overwhelming burst of the explosion, the flash from which the steadiest eye shrinks, and the irresistible arrow of the lightning, which no earthly substance can withstand, speak of something fearful, even independently of the personal danger which they may whisper. They convey far more than any other appearance does, the idea of a superior and mighty power, manifesting displeasure, and threatening punishment. Yet we find that this is not the language that they speak to the physical inquirer: he sees these formidable symptoms only as the means or the consequences of good. What office the thunder-bolt and the whirlwind may have in the *moral* world, we cannot here discuss; but certainly *he* must speculate as far beyond the limits of philosophy as of true piety, who pretends to have learnt that there their work has more of evil than of good. In the *natural* world, these apparently destructive agents are, like all the other movements and appearances of the atmosphere, parts of a great scheme, of which every discoverable purpose is marked with beneficence as well as wisdom.'*

* Whewell's Bridgewater Treatise, p. 112.,

FIRST WEEK—FRIDAY.

CLOUDS.

An important part of the machinery of the atmosphere is the formation of clouds, and their condensation into rain. We have elsewhere noticed the immense and constant evaporation which takes place from the land and sea, and the great quantity of moisture which is, in consequence, at all times floating around and above us. This moisture is sometimes held in solution in the atmosphere, and then it remains invisible, or can only be observed by an undulating motion, apparent in warm and clear weather, near the surface of the earth, occasioned by the constant change in the density of the medium, as it rises in steam from the soil. But when the water mingled with the atmosphere, comes in contact with a stream of cold air, which reduces its temperature below the point of deposition, it is immediately condensed, and passes into the form of mist; and this mist, when produced at some distance above the ground, takes the appearance of a cloud. As soon as a cloud is formed, its increased specific gravity will cause in it a tendency to descend; but, as it falls, it will probably pass into a warmer region, where it will again be evaporated, and pour its mixture upward till it once more reach a temperature sufficiently low to recondense it, when it will again begin to sink. This oscillation, however, will cease to take place in circumstances where the temperature and moisture are so balanced, that the evaporating process is on the point of commencing, or rather has actually begun; and the situation where this condition occurs, is generally found to be between two or three miles above the surface of the earth. Here, if a further reduction of temperature suddenly or extensively take place, assisted by the influence of electricity, larger drops are produced, and the cloud, condensed into rain, falls in that form to the ground.

The changes I have mentioned are doubtless greatly pro-

moted by opposite currents of wind, which, coming in contact with each other, when of different temperature, and therefore differently charged with humidity, destroy the equilibrium, and produce rain. These currents, again, are produced chiefly by an unequal distribution of heat, which causes one column of air to ascend on account of its superior lightness, and another to take a downward course, on account of its gravity. It is thus that an interchange of air is constantly taking place between the equator and the poles. This disturbance has an extensive influence; because, when any considerable portion of the air is removed, the surrounding atmosphere must rush in to fill the vacant place, and thus currents are formed in all directions; while these, again, in their passage, producing condensation or evaporation of moisture, as has been said, by that very process, alter the equilibrium of the air, and increase or diminish the force of the wind. There is thus a very complicated operation continually going on in the atmosphere, which forms the machinery of the weather.

The circumstance to which we have at present to attend, is the formation of clouds; and I have to state, with regard to this subject, that there is here, as in every other atmospherical arrangement, abundant proof of providential superintendence. There are, indeed, so many and such powerful agents in operation, in constant opposition or combination, that it may be difficult, if not impossible, to trace the law by which the effect is produced; but that the alternations of clouds and sunshine, of moisture and drought, taken at an average, are salutary to vegetation, no person need be informed.*

* 'In the midst of all this apparent confusion, however,' says Mr. Whewell, after enumerating the effects produced by the different laws regulating air and evaporated moisture, 'we can see much that we can understand; and, among other things, we may notice some of the consequences of the difference of the laws of temperature, followed by steam and by air in going upward. One important result is, that the atmosphere is much drier, near the surface, than it would have been, if the laws of density and

Now, what is particularly worthy of notice, is the controlled and regulated nature of this arrangement. There is no reason that we can perceive, why the relations between moisture and heat might not have been different from what actually exists, and a very slight change in these relations would apparently be sufficient seriously to affect the welfare of plants and animals. Why are clouds formed at all? Or, being formed, why is the place assigned to them so high in the atmosphere? And, again, why is the sun not constantly obscured by clouds; and why are these clouds liable to be formed into rain, and to fall in such genial showers upon the earth? We well understand the *final cause* of all this. We perceive in these arrangements a remarkable suitableness of atmospheric influences to the nourishment and health of organized existences; but it seems impossible to maintain that there is any thing in the mere mechanical powers existing in the atmosphere, which, of themselves, and without a wise adaptation to each other, could tend to produce these salutary consequences. No one can say that thus it must necessarily have been. That it is so, therefore, implies benevolent design. The only account that can be given of such facts is, that an intelligent Creator has so modified and adjusted the powers which exist in the atmosphere, as to fit them for the uses to which they are applied.

Nor must we forget, that while the existence of clouds, and the peculiar laws by which they are regulated, are beauti-

temperature had been the same for both gases. If this had been so, the air would always have been saturated with vapour. It would have contained as much as the existing temperature could support, and the slightest cooling of any object would have covered it with a watery film like dew. As it is, the air contains much less than its full quantity of vapour. We may often cool an object ten, twenty, or thirty degrees, without obtaining a deposition of water upon it, or reaching the dew point, as it is called. To have had such a dripping state of the atmosphere as the former arrangement would have produced, would have been inconvenient, and, so far as we can judge, unsuited to vegetables, as well as animals. No evaporation from the surface of either, could have taken place under such conditions.'—*Whewell's Bridgewater Treatise*, pp. 104, 105.

fully adapted to the heat and light, so as to conspire with these agents in promoting the growth and perfection of the organized world, they also form appearances exceedingly grateful to the taste which the Creator has implanted in his rational offspring, and conducive to enjoyment. The vicissitudes of sunshine and shade, which the formation and dispersion of clouds produce, form an agreeable variety. The lights and shadows cast over a landscape, by the operation of this cause, are frequently productive of much pleasure, from the effects of contrast and of harmony in the scenery. Whether the sun bursts in his glory from a cloud, or casts a modest veil over a neighbouring slope, or rests calmly on the distant hills, or drives fleeting shadows across the fields and meadows, while a pleasing warmth pervades the softened air, and mingled sounds of industry and enjoyment are heard on every side, the mind experiences a delightful emotion, which cannot easily be defined, but is obviously derived from the constitution bestowed upon us by a benevolent Creator.

Nor, when we look from the earth to the sky, do we find less reason for acknowledging that a paternal attention has been paid to the gratification of our feelings. The clouds are made to assume a variety of shapes and shades, sometimes beautiful, sometimes sublime, almost always interesting and agreeable, especially during the summer months. The delicate tints which streak the morning sky, when the sun shoots his earliest beams from beneath the horizon, and seems to 'rejoice as a bridegroom to run his race,'—the fervid glow which is shed over the heavens, when he 'looks in his beauty from the clouds, and laughs at the storm;'—and especially the magnificence with which he sinks to rest, while the clouds, which calmly await his departure, resting on the verge of the horizon, appear to be clothed in their gorgeous drapery of gold, scarlet, and purple, in honour of the retiring monarch,—all these appearances are undoubtedly calculated, it cannot be too much to say *intended*, to fill the heart of the spectator with admiration and delight.

These feelings, when associated with religious sentiments become exalted and refined. The man who has been accustomed to see God in every thing, receives from all his blessings a satisfaction peculiar to himself; but the pleasures which he derives from objects of taste are especially affected by this principle. He owns them as a direct emanation from a Father's love; he feels a present deity; and, while his heart expands with a sense of the beautiful, and sympathizes with sounds, and sights of enjoyment, he rises beyond the boundaries of earth, to the infinite and self-existent Creator, and expatiates on the perfections of Him who is the source of all beauty and all happiness.

FIRST WEEK—SATURDAY.

DEW.

All have been struck with the beautiful phenomenon of dew, and must have had frequent occasion to observe its beneficial effects. A single dew-drop, so beautifully pure and clear, and so lustrous in the morning sunshine, is an object well worthy our attention and admiration. And when we see the fields and lawns, with their innumerable plants, strewn with 'orient pearl,' and sweetly refreshed by the copious moisture, so as to be prepared for the scorching heat of day, can we fail to be delighted by the beauty of the scene, and profoundly impressed by the inimitable skill with which all vegetation is thus watered and revived!

If we inquire into the causes of dew, and the periods of its more abundant formation, we shall find the same marks of Creative skill and benevolence that meet us in every other field of physical research. These causes may be very briefly stated. In all substances heat exists in a greater or less quantity; and from these it *radiates* in all directions, like light from a luminous body. Thus there is a constant and mutual interchange of heat between all kinds of bodies on

the earth's surface, and, consequently, a tendency to a universal equalization of temperature. Heat is also given off from bodies by conduction; but conduction, strictly speaking, is only a particular, though a very remarkable, case of radiation. The process of conduction, moreover, is much less general and important than of direct radiation, which, in the great operations of Nature, is the chief means of transmitting heat from one substance to another. A great portion of the solar heat absorbed by the earth, in the course of the day, is radiated into the cooled air during the night; and the radiation proceeds till the surface of the ground is at a lower temperature than the surrounding atmosphere, provided only the sky be serene. If the sky be cloudy, most of the radiated heat is re-transmitted from the clouds to the earth, so that the temperatures of the earth and atmosphere remain nearly equal. When the heat is not radiated back, but allowed to escape into the higher regions of the atmosphere, and the exposed surface of the earth, and of the substances upon it, thereby becomes colder than the air, it results from the principle of the condensation of vapour by cold, that a deposition of the invisible moisture floating in the air takes place. This moisture generally exists in the greatest quantity when the heat of the sun is powerful and continued; and at nightfall it is ready to be condensed into visible globules by the relatively cold substances with which it everywhere comes in contact. These globules of condensed vapour form what is called dew, and should be carefully distinguished from the moisture which is formed into clouds, and which visibly descends in the shape of rain or fog. Thus, dew cannot properly be said to fall, as it has been erroneously supposed to do. It is merely caused by the condensation of moisture contained in the air that is in contact with a cold substance; and its formation is strictly analogous to that of the moisture which appears on the inside of windows when the external air is suddenly chilled,—of that which appears on a cold stone or piece of metal when we breathe upon it,—or of that which is

observed on a glass of cold spring water, in hot weather, or in a warm room.

It has been ascertained, by experiment, that dark coloured bodies radiate heat, and therefore cool with greater rapidity than bodies of a light colour. A dark or green substance, if it be exposed to the night air, will be covered with dew, while substances of a brighter colour, in similar circumstances, will remain almost dry. If the surfaces of the latter be smooth or polished, their radiation will be still less perfect, and their dryness consequently greater. In our morning walks, we frequently see the green grass and bushes plentifully bedewed, while the light materials of the road remain untouched. Here we perceive a new and beneficial effect of the prevailing colour of vegetables. Green is not only a lively and beautiful colour, and less hurtful to the eye, but green substances are among the best radiators of heat, and are therefore most liable to condense the moisture of the surrounding air. Thus the leaves of plants, which require a constant supply of moisture, being mostly of a green colour, are admirably fitted to procure it.

In warm and settled weather, when the hot day is succeeded by the calm clear night, dew is most abundant. Now, it is just then that it is also most necessary; for the heat of the sun, unmitigated by any cloudy screen, increases greatly the general evaporation, and there is no rain to compensate for the increased quantity of moisture of which plants are thereby deprived. In cloudy weather, when the solar heat is mitigated, and rain is more abundant, dew is less necessary to the health and nourishment of plants; and it is precisely such weather that is most unfavourable to its formation. The clouds, as we have already seen, radiate back the heat transmitted from the earth, and thus prevent the temperature of the ground from sinking to the *dew-point*. Frequently, when a clear nocturnal sky is suddenly covered with clouds, the dew already formed is evaporated, as the temperature of the earth is increased by the counter-radiation from above. And, again, should the clouds clear away and

the sky become serene, dew immediately begins to form. Thus, there is not unfrequently an alternate formation and evaporation of dew in the course of the night, as the aspect of the sky fluctuates between clear and cloudy. In covered or shady spots, it has been observed that there is always the least dew. The shade or covering radiates back the heat, and thereby keeps up the temperature of the ground below. Thus, in the recesses of the wood,—where, on account of the impervious shade, there is least evaporation during the day, little or no dew is formed upon the rank grass, which is otherwise well provided with moisture: so little superfluity of means is there in the works of Nature. In the production of any given effect there is an economy of resources which, while it greatly enhances to our apprehension the wisdom and skill of the Creator, is well fitted to teach us a useful moral lesson.

How beautiful is the dew on a calm summer morning! It freshens every thirsty plant, washes every delicate flower, and gives new lustre to its finest tints. It cools and refreshes the whole surface of the ground. And as soon as the sun's earliest beams shoot forth from the eastern horizon, its innumerable drops twinkle in the golden light, like a fallen shower of diamonds. As the sun ascends, they disappear before his beams, partly absorbed by the plants on which they lay, and partly evaporated by the increasing heat. At night the moisture that composed them may form new globules, and invigorate the vegetation of other fields. Thus, in every department of Nature, there is an endless series of movements and transmutations. On the earth's surface all is activity and unceasing play; all is subservient to the supporting in life and beauty the animal and vegetable world. The watery particles, in particular, display the most useful volatility. They ascend into the air by evaporation; they thence fall in the shape of dew, mist, rain, or snow. They re-ascend, or, incorporated with the waters of rivers, visit the ocean. But even there they feel the solar influence, and again mount on high to visit the fields and mountains they

watered before, or haply to bedew the plants of another hemisphere.

Thus, in the appearance and effects of dew, we find the beautiful conjoined with the useful. In its formation, we discover the most exquisite contrivance; in the times and places of its appearance, the most striking adaptation to the economy of vegetables. Yet by no intricate or peculiar arrangements is it produced; it forms no exception to the simplicity of Nature. Its varied and beautiful phenomena are the result of but three general laws,—the radiation of heat, and the condensation of vapour by cold, combined with the moulding power of corpuscular attraction, which forms it into globules. Here, therefore, let us admire and adore that Divine wisdom which, by means the most simple, produces the most wonderful effects, and which is everywhere rendered subservient to the designs of an unbounded goodness. J. D.

SECOND WEEK—SUNDAY.

SCRIPTURAL ALLUSIONS TO THE DEW.

Most of the grand phenomena and aspects of Nature are mentioned in Scripture, and so applied as to teach or illustrate some important lesson. They are spoken of as declaring the glory of God in creation; they are employed to represent his dealings with the children of men. The snow, the hail, the thunder, and the storm, are appealed to as grandly showing forth his power and terrible majesty; the wind, 'that bloweth where it listeth,' the early and the latter rain, and the gently dropping dew, are used as appropriate images of the blessings continually showered down from on high, and especially of the influence of the Holy Spirit upon the soul. The Bible, designed to be an intelligible record of Divine instruction, abounds in imagery borrowed from material nature, and expressly adapted to arrest and charm the attention. It contains many beautiful allusions to the phenomena of dew, a

few of which we propose making the subject of this day's paper.

The beneficial effects of dew, in reviving and refreshing the entire landscape, have already been adverted to. How frequently do we observe the aspect of the fields and woods improved by the dew of a single night. In the summer season, especially, when the solar heat is most intense, and when the luxuriant vegetation requires a constant and copious supply of moisture, an abundant formation of dew often seasonably refreshes the thirsty herbs, and saves them from the parching drought. In Eastern countries, like Judea, where the summer is fervid and long continued, and the evaporation excessive, dew is both more needed, and formed in much greater abundance, than in our more temperate climate. There it may be said to interpose between the vegetable world and the scorching influence of a powerful and unclouded sun—to be the hope and joy of the husbandman, the theme of his earnest prayer and heartfelt gratitude. Accordingly, the sacred writers speak of it as the choicest of blessings wherewith a land can be blessed ; while the want of it is with them almost synonymous with a curse. Moses, blessing the land of Joseph, classes the dew among 'the precious things of heaven;'* and David, in his lamentation over Saul and Jonathan, poetically invoking a curse upon the place where they fell, wishes no dew to descend upon the mountains of Gilboa. The Almighty himself, promising, by the mouth of one of his prophets, to bless his chosen people, says, 'I will be as the dew unto Israel; he shall grow as the lily, and cast forth his roots as Lebanon.'† Here the refreshing and fertilizing effects of dew beautifully represent the prosperity of the nation which God specially favours and protects. The dew is also employed, by the prophet Micah, to illustrate the influence of God's people in the midst of an evil world, where he says, that 'the remnant of Jacob shall be in the midst of many people, as a dew from the Lord.'‡ What emblem more expressive of that

* Deut. xxxiii. 13. † Hosea xiv. 5. ‡ Micah v. 7.

spiritual life, in some of its members, which preserves a people from entire corruption and decay!

Another beautiful application of the dew in Scripture, is its being made to represent the influence of heavenly truth upon the soul. In the commencement of his sublime song, Moses employs these exquisite expressions:—'My doctrine shall drop as the rain, my speech shall distil as the dew; as the small rain upon the tender herb, and as the showers upon the grass.'* Similar passages might be quoted from the sacred writers, wherein, by a felicity of comparison that all must at once acknowledge, the word and ordinances of God are likened to the dew of the field. How strikingly the reviving effects of dew, upon the parched and thirsty vegetation of the sun-scorched plain, typify the moral and spiritual freshness diffused by the word preached in its purity, and received with faith and love. As the dew of a night will sometimes bring back beauty and bloom to unnumbered languishing plants and flowers, and spread a pleasant freshness over all the fields, so will some rich and powerful exposition of revealed truth, or some ordinance, dispensed with genuine fervour, not unfrequently enliven and refresh a whole christian congregation, or even spread a moral verdure over a large portion of the visible church. If the soul be stained in its intercourse with the world—if, like the grass on the way-side that is covered with dust, it contract impurity in the beaten paths of life, the word of God falls upon it with a refreshing influence, like the dews of night upon that grass, to water it, and to wash away all marks of contact with surrounding corruption. If it be scorched by the withering sun of persecution, and pine for spiritual nourishment and support, that same word bedews it with the sweetest influences, and affords it sustenance, in richness and salubrity like that of the heavenly manna itself.

But let us not forget that the word of God sheds a healing influence only when it is rendered effectual by the Spirit of all truth. The Spirit worketh through the instrumentality of the word; silently, secretly, and powerfully worketh; fall-

* Deut. xxxii. 2.

ing gently, operating unseen, and diffusing refreshment around, like the balmy dews of night. Of the Spirit's agency the dew is, indeed, the finest and aptest illustration. As dew to the parched and drooping flower, so is the Spirit shed upon the Christian's soul; as the 'dew of Hermon,' or 'the dew that descends upon the mountains of Zion,' spreading freshness and beauty over the whole surface of the ground, so is the Spirit poured out in rich abundance upon the Church, the spiritual Zion, in times of reviving and refreshing from the Lord.

As we spring from our couch, therefore, on the bright summer morning, and walk joyfully forth into the fragrant fields, to breathe the inspiring air, feast our eyes upon the glowing mixture of colours in which all nature is arrayed, and listen to the sweet and various music that ascends from every grove, let us not fail to derive a high spiritual lesson from the dew that is so thickly strewn upon the grass beneath our feet. Distilled in the silent night by the reciprocal influences of heaven and earth, it bathes and refreshes each blade and flower with its stainless moisture. Let us regard it as the chosen image of God's choicest blessing, the cleansing and sanctifying influence of his Spirit upon the heart of man. J. D.

SECOND WEEK—MONDAY.

ADAPTATIONS OF THE FACULTIES OF LIVING BEINGS TO THE PROPERTIES OF LIGHT AND AIR.

The fluids which surround our globe, so remarkable and so diverse in their properties, have already been considered in various aspects and relations, both as respect themselves and organized existences. There are, however, some striking adaptations of the animal creation to these fluids, which have not yet been considered. Among these, the conformation of the organs of sight and hearing are particularly worthy of notice.

Light possesses very peculiar qualities. Its rays dart with inconceivable rapidity; they are of different properties, and are either reflected in all possible directions from the objects on which they strike, or absorbed by these objects, or otherwise they pass through them. Now, there is a very artificially formed instrument in living bodies, obviously and most beautifully adapted to these qualities. That instrument is the eye. I cannot stop to enter into a minute examination of this curious and complicated machine. This has already been done very effectively, by Paley; and I must refer my readers to his ingenious comparison between the eye and the telescope, as one of the most interesting and triumphant arguments for Designing Wisdom which can easily be conceived. I must, however, request the reader to observe, that without the eye, light would be of no use to living creatures. It is not the object of any of the other senses. It cannot be perceived either by touch, taste, smell, or hearing;—yet its properties are of essential importance to animal life. A *camera obscura** is therefore bestowed on living beings, consisting of a small hole or opening in an opaque substance, through which, by means of a transparent medium, the rays of light are transmitted,—a finely formed lens, which collects these rays, and concentrates them, and a sheet or retina on which they fall at the proper focal distance, creating an exceedingly minute, but most complete and accurate, representation of external objects. This combination, so obviously artificial, forms an optical instrument, at once complete of its kind, and differing in its construction from any thing else in organized nature. The contrivances which constitute the lens and the retina, are peculiarly striking. The former is constructed with a most perfect and minute attention to the laws of optics; the latter is a singular and beautiful piece of workmanship, being an exceedingly delicate network of nerves, curiously interwoven, and ending in a nerve, which makes its passage to the brain. Here the mechanism is lost; human ingenuity can trace it

* The eye is adverted to, under this name, in '*Winter*' 'Fourth Week, Thursday.'

no farther; because it is here that the mysterious and inscrutable principle occurs, which connects mind with matter, and conveys ideas of material objects to the sentient and reasoning powers. But up to this point, the contrivance is distinct and admirable. There is a mutual adaptation between the eye and the properties of light, which clearly exhibits benevolent intention. The rays reflected from all surrounding objects, under the various modifications I have mentioned, are received into every eye that is turned to them, and give rise, in the mind, to the various ideas of light and shade, of shape and colour, of distance and nearness, of beauty and deformity; and thus disclose many fields of useful knowledge, which would otherwise have been shut, and unfold sources of exquisite and varied enjoyment, which would otherwise have been excluded; while they afford a theatre of exertion, without which the necessaries of life could not have been procured, and almost all the varieties of animated existence must instantly have perished. 'If this does not prove appropriation,' says Paley, after taking a similar view, 'I desire to know what would prove it.'

The adaptations between the ear of animals and the air, are not less remarkable. We cannot so distinctly trace the uses of the various parts of the ear, as an instrument of sound, as we can trace those of the eye as an instrument of sight; but we can observe enough to discover, that they are no less complex and artificial; and, at all events, they equally answer the intended purpose. We are surrounded with an elastic and fluid medium, in which impulses create vibrations. These vibrations are scarcely perceptible to any of the other senses, and, if they were, could be of very little utility; but the ear is bestowed, and is made capable of receiving such impressions from these vibrations, as are productive of the highest advantages. If any person will attend to the various uses of sound, he will at once perceive of what importance to animal existence is the possession of an organ, by which it is perceived. To the inferior animals, it is that which warns them of danger; which attracts them to each other; which

assists them in procuring their natural food; which is the medium of expressing their desires or aversions, their satisfaction or anger, their terror, their distress, their joy, or their sense of safety. Perhaps it may sometimes be the means of even more extensive communications between individuals of the same species. To man, it serves all the purposes we have stated, and much more. Air can be 'shaped into words,' and convey articulate sounds to the ear, which form a most wonderful and important system of mutual communication, and contribute, in an amazing degree, to the happiness and improvement of the human race. To form a proper estimate of the advantages derived from this source, perhaps the readiest way is to suppose, that there was no such faculty as that of hearing. We pity a deaf person, on account of the privations to which he is subject; yet he possesses many advantages, from living among those who are endowed with the gift of which he is deprived. Let it be imagined, that the faculty of hearing had been entirely denied to the rational creation; and how many sources of safety, of enjoyment, and of improvement, would have been withheld! The want of so useful a medium of communication, would not only subject us to many dangers which it teaches us to avoid, but would throw an effectual barrier in the way of advancement in the arts and comforts of social life; would shut us out from all the enjoyments of melody, and from those thousand nameless sympathies communicated by the intonations of the human voice. A dumb world would be a world of barbarism. The rational powers would remain unexpanded, the stimulus to exertion would be wanting, and man would be reduced to a level with the brutes.

Now, it is on the wonderful adaptation between the ear and the external air, that the perception of sound depends, and especially that exquisite perception of the minute distinction of sounds, which constitutes the power of receiving communications by means of language. The delicacy of this adjustment will be seen by reflecting on the difference which would be produced by only a slight variation, either in the auditory

organ or in the air. Some particular states of the atmosphere are better adapted for the transmission of sounds than others; and it is easy to suppose, that the relations of this element with the ear, might be so altered as to render the vibrations either too loud or too low for utility. If, for example, a man attempt to speak after inhaling hydrogen gas, his voice will scarcely be audible.

Again, the ear is not merely adapted to the intensity of the aerial vibrations which constitute sound, but to various other modifications. The power of perceiving the pitch of voice, or the difference between acute and grave,—the quality of sound, or that which distinguishes one voice or sound from another, as well as that which is most important of all, the power of perceiving articulate sounds,—all depend on the adjustment to which we have alluded. The familiar circumstance of one person possessing a musical ear, of which another is altogether destitute, may serve to illustrate these remarks.

In addition to all this, we have the organs of animals, fitted for uttering each its own appropriate sounds; by virtue of which the lion roars, the horse neighs, the cow lows, the sheep bleats, and the dog barks; and, above all, man is gifted with those wonders of voice, by which he is enabled to form for himself the complicated structure of language, and thus to give full expression to his inward sentiments and feelings.

Most assuredly whoever contemplates these finely and skilfully adjusted relations, with candour, cannot fail to recognize an intelligent Designer. When we are asked how it comes that the eye should be formed for light, and light for the eye; or how it happens that the ear and the organ of speech should be so conformed to each other, and to the surrounding fluid of air, and this fluid to them, that from these combinations such incalculable blessings should flow to living creatures, and especially to man, it seems altogether vain to attempt any other reply, than that this is the work of an all-wise and benevolent Creator. Let any man examine these questions, with what minuteness he pleases, and attempt, by what-

ever ingenuity he may legitimately exercise, to escape from this conclusion, and he will only be more powerfully compelled to acknowledge the hand of a wonder-working and paternal God.

The instance of the eye is particularly striking, because it is so remarkably artificial, or rather because it can be so directly compared with works of human art. It is, as we have said, a complete and most skilfully constructed optical instrument; and its comparison with the *camera obscura* or the telescope, brings out so many points of resemblance, that it seems impossible to attribute contrivance to the one, and deny it to the other. But there is another sentiment which such a comparison forcibly impresses on the mind. There are points of contrast, as well as of resemblance; and in all these the unspeakable superiority of the Divine Artificer is most conspicuous. The human instrument is but a feeble and imperfect imitation of that which has come from the hands of the Creator. In the latter, there are many things which art in vain attempts to imitate, the mechanical skill is so exquisite, and the adaptations so nice.—And then with what waste of thought, with what laborious stretch of ingenuity, with what patient toil and pains is the human instrument constructed. Who will venture to compare with this the creative power of the Omnipotent?

SECOND WEEK—TUESDAY.

GROWTH OF VEGETABLES.

I HAVE, in a former volume, given an account of the first development of vegetable productions, and detailed the general principles of their organization, and of their vital powers.* What remains, as introductory to a sketch of the properties of individual plants, which arrive at maturity during the sum-

* 'Spring.'—Articles Vegetation, Development of Seeds and Plants, Vital Powers of Plants, &c.

mer months, is to explain their mode of growth, and the various contrivances by which they are adapted to the climate and localities in which they are found.

The first thing of observation on this subject, is, that two different modes have been adopted in the growth of vascular plants, with obvious reference to the state of external nature in the latitudes where they are respectively placed; the one of which is named *exogenous*, the other *endogenous*. In the former, the successive additions to the substance of the stem, are made on the exterior side of the parts from which they proceed; in the latter, this process is reversed, and the growth is the result of additions made internally. All the trees of the regions north of the tropics, belong to the *exogenous* order; while a proportion of tropical plants belong to the *endogenous*.

Of endogenous plants, the palm-tree may be taken as an example. The stem of this tree, in its usual state, is perfectly cylindrical; it attains a great height, and from its summit sprouts a considerable tuft of leaves. It is composed of an extremely dense external layer of wood, while the texture of the interior gradually becomes softer and more porous as it approaches the centre. With regard to its essential character, however, it appears to be uniform in every part, having neither medullary rays, nor true outward bark, nor any central pith; in all which respects it differs entirely from the ordinary exogenous trees.

In the first stage of its growth, a circle of leaves is formed, shooting upwards from the neck of the plant, and attaining, during the first year, a certain height. The following year another circle of leaves arises, which grow from the interior of the former circle, forcing it outwards as their vegetation advances, and as woody matter is deposited within. Thus the growth proceeds, each succeeding year producing a fresh crop of leaves, intermixed with ligneous matter; and these, exerting an outward pressure, extend and swell outwards the layers in which they are enclosed, until the latter, acquiring greater density, no longer admit of further distension, and remain permanently fixed. This solidity of texture first takes

place in the outermost and oldest layer, the internal layers being consolidated each in its turn. As soon as the outer layer is rendered too hard for yielding to internal pressure, the vegetative force of the inner layers is immediately directed upwards. In this manner the tree rises by successive yearly stages, the growth always proceeding from the interior; a mode of development which has been compared to the drawing out of the sliding tubes of a telescope. The whole stem, whatever height it may contain, never increases its diameter after its outward layer has been consolidated. A circle of leaves annually sprouts from the margin of the new layer of wood, leaving, when they fall off, a circular impression round the stem, by means of which the age of the tree may be ascertained.

Notice has elsewhere been taken of the complicated structure of exogenous trees,* which are composed of wood, bark, and pith. A few words may be here said of their mode of growth, which differs so entirely from that above detailed. The plant, in both cases, rises from a germ; but, in the trees now under consideration, the stem gradually swells in thickness as it extends in height, consisting of the first layer of wood, with its central pith and its covering of bark. This is the process of the first year. In the succeeding spring a fresh impulse is given to vegetation, and a new growth commences from the upper end of the original stem, as if it were the development of a new bud; and, at the same time, a layer of cellular tissue is formed by the deposition of new materials on the outside of the former wood, and between it and the bark. This is followed by a second layer of wood, enveloping the new layer of cellular tissue. While this process is going on in the wood, corresponding changes take place in the bark, and a new layer is added on its inner surface, which is called the *liber*. All these additions to the thickness, of course, press against the bark, which, being elastic, yields to the pressure, to a certain extent, but at length gives way, forming numerous

* See 'Spring,'—Development of Seeds and Plants, &c.

cracks; and these are filled up by the exudation of the vegetable matter, called *cambium*, formerly mentioned.

Such is a general statement of the different processes of growth in exogenous and endogenous plants, constituting a very striking difference in the constitution of vegetable substances in different climates. That this difference is the contrivance of Creative Wisdom to adapt vegetation to the diversities of light and heat, and the other constituents of the weather in various latitudes, cannot reasonably be doubted by any person acquainted with the system of nature; but the processes of vegetation are too obscure, and the effects of the atmosphere, under different modifications, are too little known, to enable us distinctly to show the final causes of these alterations; and all, perhaps, that can be positively asserted on the subject is, that the one class of plants droops and decays when transferred to the locality of the other,—a sufficient proof of a profound and calculated adaptation.

In various other particulars, not elsewhere mentioned, the adaptation can be more easily traced, because it depends on known mechanical laws. Thus, the graceful curve with which the stem of a tree rises from the ground, is the form obviously best calculated to give stability to the trunk. Evidence of express mechanical design is likewise afforded by the manner in which the trunk is subdivided into branches, spreading out in all directions, manifestly for the purpose of affording the leaves a greater extent of surface, and thus enabling them to receive the fullest action of both light and air, so essential to the health of the tree. The branches also are so constructed, as to yield to the irregular impulses of the wind; and again, by their elasticity, to return to their natural positions; and by their alternate inflexions on opposite sides, to promote the motion of the sap, and thus to contribute to the healthy action of the vegetable powers.

If any person is inclined to attribute the circumstances we have mentioned, to the accidental combinations of unintelligent agents, the best answer which can be given is to refer him to the thousand other instances of design which appear

in every department of nature. We do not rest the argument on a few insulated facts; but confidently appeal to the whole tendencies of the principles which regulate the material world, and to the innumerable minute particulars which display an intelligent and beneficient Hand. The facts above detailed might have little weight if they stood alone; but they are individual illustrations of a universal system, and in this light are valuable, as adding to the cumulative evidence, which so irresistibly constrains the mind to acknowledge a present Deity.

SECOND WEEK—WEDNESDAY.

HORTICULTURE.—PRINCIPLES ON WHICH IT IS FOUNDED.

In turning to the consideration of vegetable substances, as they exist during the summer months, it is necessary that we should make a very limited selection, for they are so various, and their history and properties are so interesting, that volumes might easily be written on this subject alone. For this reason, I shall confine myself to plants which man has appropriated to his own use; and shall commence with the varied products of the garden, noticing those only which are the most valuable, or the most remarkable.

Gardening is a branch of agriculture at once important and interesting. It depends for its existence on the bountiful provision which the Creator has made for the supply of vegetable substances fit for human nourishment and enjoyment during all the productive seasons of the year, exclusive of the cereal plants, which are only reaped in autumn, and seem more especially destined to furnish food to be stored up for relieving the wants of the unproductive season of winter. The paternal care of the Creator, in the respect I have mentioned, is very conspicuous. The constitution of these different kinds of plants points out their intended uses; and there is at once a grateful variety, and a wise adaptation to the circumstances

of man in such productions, which cannot be sufficiently admired. Had the whole of Nature's bounties been crowded into the autumn months, not only would the unequal distribution of labour, elsewhere mentioned,* have been productive of serious inconveniences, but we would have been deprived of the healthful and agreeable varieties afforded by fresh culled vegetables, with their succulent properties and pleasant flavour. While corn is, in every respect, wisely contrived for hoarding, the grain being full of a hard and nutritious farina, which is stored in small bulk, and easily preserved, and the straw being a useful fodder for cattle, the classes of plants which we have now to consider, do not, generally speaking, possess such qualities, because these are not necessary for their particular object; but they are endowed with others not less admirably or beneficently suited to the purposes of nourishment; and they are evidently intended to supply a desideratum in the provision made for the subsistence of the highest class of animated existences.

There is a principle in the condition of man, already frequently alluded to, and which must be constantly kept in view in forming an estimate of Creative Intelligence regarding the adaptation of external nature to that condition,—I mean the obvious intention, that his powers and faculties should be stimulated by the necessity of laborious exertion. For this purpose it seems essential, or at least highly important, that his food should be naturally scanty, but that it should be capable of being rendered abundant by cultivation. The operation of this providential arrangement has been already explained in relation to agriculture;† and the principle holds no less true as regards the produce of the garden. The herbs, plants, and flowers, which form the delight and profit of the horticulturist, are found, in their natural state, sparingly scattered over many regions of the earth. They exist just in sufficient quantities to attract the attention of man, and to pre-

* See 'Spring.'—Article—The Labours of the Husbandman wisely Distributed over the Year.

† See 'Spring,'—Origin of Agricultural Labour, &c.

serve the species till he shall appropriate them. But they do not, in general, grow naturally in such abundance as to form very important articles of food. Other plants, such as grasses, which are created for the food of numerous tribes of the lower animals, and trees of the forest, the uses of which are so extensive both for man and beast, are endowed with vegetative qualities which tend to overpower and supplant, or rather to confine to narrow localities, the vegetable productions of which we speak. While this is a wise adaptation with reference to those animals which 'neither sow nor reap, nor gather into barns,' because it is thus that the universal Father provides for their subsistence, it is no less wise as respects the race who do exercise these functions, and whose industry and ingenuity it calls forth. Man is thus compelled to adopt and cultivate the succulent food destined for his use; and in the exertion of the bodily and mental faculties which his Maker has bestowed, while his toil is rewarded, he finds a thousand collateral advantages accruing to him, and accumulating in a constantly increasing *ratio*.

What greatly adds to this beneficial effect is, the power with which culture is endowed of improving the natural productions subjected to its influence. The flowers, the esculent vegetables, and the roots which the horticulturist rears, all receive, under his plastic hand, new and important qualities; or, at least, the properties they naturally possess, acquire additional value. Of one class, the colour, the perfume, or the symmetry, is improved,—of another, its size, its richness, or its succulent or prolific qualities. That which in its natural state was a worthless weed, is converted by judicious management, into a valuable garden herb, or beautiful flower; and even the thorns and briars of the wilderness become the ornaments of our parterres and lawns.

Such are the principles impressed on the vegetable creation, which gave origin to the skill of the gardener, and have raised his laborious profession to the dignity of a science. The herbalist, the florist, and, in a still higher department, the botanist, each finds exercise for his powers, and regard for

his labours, in the various duties of horticulture; and nowhere does the lover of rural pleasures acquire a more exhilarating or healthful pursuit, than in the cultivation of the field of contemplation which such studies unfold to him. There is in this delightful employment, so much at once to gratify and refine the taste, to enlarge the mind, and to occupy the pious feelings, that it is not surprising that, in every age of civilized society, it should have formed a favourite relaxation to the higher ranks; while, in the more humble, but certainly not less important, view of a useful means of subsistence, there is so much to recommend the produce of the garden to general attention, that it could not fail to become an object of desire to all classes of the community.

It is obvious that the art of the gardener must increase in importance with the advancement of society, and especially with the progress of commerce. At first the gardens of the poor, and even of the middle classes, would contain nothing but a few indigenous plants of prime necessity. The rich, themselves, would, in the infancy of society, differ from their poorer neighbours more in the extent than in the variety of their horticultural productions. But, as soon as commerce had opened up a ready intercourse with foreign nations, the case would be quickly altered. There would be an extensive interchange of the produce of the soil in different countries, and a stimulus would be given to the skill and industry of the gardener, which would constantly increase, and would be attended with important advantages. The principle of competition, in short, and the desire of profit, which operates so extensively, and in some respects so beneficially, in regard to commercial pursuits, would not fail to be introduced into this department. The wider field laid open would operate, along with the increasing opulence and extent of the population, to give importance to horticultural labours, and a new class of men would be introduced, by the separation of the profession of gardening from other avocations. This is, in reality, the view, as we shall presently see, which history affords of the progress of the art. Originally, the duty of cultivating the

little patches of garden ground devolved almost exclusively on the members of the family,—chiefly, perhaps, on the females; but as the population became more dense, and the demand for conveniences and luxuries more eager and extensive, public gardens were formed in the neighbourhood of towns,—private gentlemen extended their garden ground,—and that was converted into a separate employment, which was originally nothing more among all ranks than what it is still among our peasantry,—a mere appendage to household labours.

SECOND WEEK—THURSDAY.

HORTICULTURE.—ITS HISTORY.

In looking back to the history of gardening, it is impossible to forget that this was the occupation of the first man. At his creation, God provided for him a garden, in which, doubtless, was collected all that could charm the eye, or gratify the appetite, and set him 'to dress it, and to keep it.' This indicates that, even in his primitive state of innocence, industrious employment—something which might gently stimulate the faculties of his mind, and afford exercise to his bodily powers—was essential to his welfare. It was not simple occupation which became part of his curse at the fall; but severe and incessant toil. His employment must have had some useful aim; and hence we may conclude that, even when creation came first from the hand of the Eternal, there was a tendency in the vegetable world to rise into too luxuriant growth, which it was necessary to restrain by art. We may go farther, and conjecture, that cultivation was rewarded then, as it is still, by forms of beauty becoming, under the plastic hand of man, still more beautiful, and objects of utility still more useful. It would be easy and delightful to expatiate on a theme so inviting to the imagination, but at present we have to deal with recorded facts.

We hear nothing further of gardens before the flood; but, very early in the history of the Israelites, and throughout its whole continuance, they are mentioned in such terms as to show that they were not only familiar to that people, but objects of enjoyment. There is nowhere, however, any mention of the productions they contained, nor of the mode of their culture, if we except the very general title which sometimes occurs of 'a garden of herbs,' and the frequent allusion to the act of watering in connexion with the name. It will scarcely fail to strike any mind which has been accustomed to turn its attention to scriptural analogies and contrasts, that as it was in a garden that Adam spent his days of innocence and happiness, so it was in a garden that He who has been emphatically called the Second Adam, experienced the mysterious and amazing agony which formed the prelude to his vicarious sufferings.

In profane history, we meet with frequent mention of gardens, as existing in very early ages, often, however, mixed up with fable, and seldom accompanied with any circumstantial account which can throw light on the taste of the ancients, or the kinds of produce which they cultivated. The hanging gardens of Babylon form some exception to this remark; but, while they convey to us an idea of expensive magnificence and extravagant luxury, the details are far too vague to satisfy the curiosity of a horticulturist, as to those matters in which he feels the greatest interest. Nearly the same thing may be observed of the Persians. They are said to have been addicted to gardening from a very early period; but we know nothing of their arts of cultivation, and we hear from historians only of those gardens which were erected to gratify the profuse taste of monarchs, or to contribute to their oriental splendour.

From Theophrastus and Aristophanes, we learn that the Greeks took pleasure in horticultural pursuits; but they only tell us, in general terms, of the cultivation of flowers, of which that elegant people were exceedingly fond. They strewed them at their convivial meetings, and religious ceremonies;

they wore them in garlands and crowns; and they attached to them mythological types and meanings which gave a peculiar and superstitious interest to their culture, and to the manner in which they were employed.

From the Greeks, the Romans borrowed many of their habits and tastes, with considerable modifications, however, consequent on their more warlike propensities. Their love of gardening may probably be traced to their admiration of the people whom they acknowledged to be their masters in the arts and refinements of civilized society. The productions which they cultivated, however, were perhaps more numerous than those which adorned the gardens of the inhabitants of Greece, because the range of their conquests was more extensive; and this active and observant people never failed to appropriate to themselves whatever was useful in the practices or possessions of the countries they over-ran; while, with a generosity which in some degree compensated for their selfishness, they were eager to communicate to the vanquished the knowledge and the arts of civilized life, which they had themselves acquired. Although we have little specific information on the subject, it may well be believed that they carried with them, wherever they made a permanent settlement, an acquaintance with the useful labours of the gardener.

In China, it is probable that horticulture was early cultivated, and the inveterate habits of that singular people render it likely that their present modes of garden culture have been handed down from a remote antiquity. The missionary Jesuits Du Halde and La Comte, who resided a number of years in China, mention in terms of commendation the manner in which gardens are managed in that country, particularly as relates to the raising of culinary vegetables; and it is even said that the Chinese are in possession of some valuable esculents peculiar to themselves. We possess, however, several additions to our flower gardens, derived from that quarter; and, among the rest, some beautiful varieties of the Camellia, Pœonia, and Rose; and there seems no reason

why, if useful vegetables, unknown in Europe, existed among them, these productions should not also have found their way beyond the bounds of the celestial empire.

In turning to the state of European horticulture, in modern times, we shall find that the changes which have taken place in society since the classic ages, have not been less remarkable in this than in other arts. Among the natives of modern Greece and Italy, there are few remains of the habits of the ancient inhabitants. They possess gardens, indeed, but they seem to take little interest in their cultivation. The same vegetable productions which we possess, are to be found in the Italian states; but, while the gardens of the peasants are only scantily supplied with gourds and Indian corn, the arts of horticulture are but languidly pursued even by the wealthy; and it is only in the gardens attached to religious houses, that we see any remains of the taste of former times. In Russia, the practice of gardening was first introduced, along with many other improvements, by Peter the Great; but it does not seem to have taken deep root, and is indeed almost exclusively confined to the higher classes.* In the adjoining kingdoms of Poland and Prussia, the peasantry have not much more taste for gardening than their less civilized neighbours. Cabbages and potatoes are almost the only vegetables which their little plots produce; but the case is different with their superiors, who raise garden productions in great variety and abundance.

France, particularly in its northern provinces, and the neighbourhood of the metropolis, is distinguished by the attention which is frequently paid to the neatness of the garden grounds, and the success with which the art is cultivated. But, above all the continental nations, the palm must undoubtedly be assigned to the Dutch, and the inhabitants of

* 'Horticulture has attained to a high degree of perfection in Russia, among its princes and nobles; and it is a curious fact, that more pine-apples are grown in the immediate vicinity of St. Petersburgh, than in all the other countries of continental Europe.'—*Library of Entertaining Knowledge.—Work on Vegetable Substances*, p. 206.

the Netherlands. Throughout these countries, as has been justly said by Sir William Temple, 'gardening has been the common favourite of public and private men,—a pleasure of the greatest, and a care of the meanest,—and indeed an employment and a possession for which no man there is too high or too low.'

The early intercourse of Spain with the New World, created a taste in that country for horticultural pursuits, and has been the means of diffusing over Europe, many useful plants, from Mexico, Chili, and Peru. In Mexico, indeed, the natives were remarkable for the ingenuity of their garden cultivation; and their chinampas, or floating gardens,* must be considered as one of the greatest curiosities of art ever produced by a semi-barbarous people.

But nowhere, with the exception perhaps of the Low Countries, is the art of horticulture carried on, among all ranks, with so much spirit and success as in Great Britain. The lowest peasant delights in the labours of his garden; and even the inhabitants of our towns find enjoyment from the cultivation of but a few yards perhaps of soil, which their circumscribed boundaries have spared to them. A taste for shrubs and flowers is universal, especially in the southern districts of England. 'The laborious journeyman mechanic,' says Mr. Loudon, 'whose residence in large cities is often in the air, rather than on the earth, decorates his garret window

* Humboldt conjectures that the first idea of these floating gardens may have been suggested by nature herself, seeing that, 'on the marshy banks of the lakes of Xochimilco and Chalco, the agitated waters, in the time of the great floods, carry away pieces of earth, covered with herbs, and bound together with roots. The first Chinampas were mostly fragments of ground, artificially bound together and cultivated.' Following up this suggestion, it would not be difficult, by means of wicker-work, formed with marine plants, and a substratum of bushes, combined with tenacious earth or clay, to construct similar gardens, of adequate dimensions. Upon these was placed fine black mould, sufficiently deep for the subsistence of the plants which it was desired to raise. The form usually given to these Chinampas, was quadrangular, and their size varied from 150 to 300 feet in length, with a breadth of from 20 to 70 feet.'—*Vegetable Substances used for Food*, p. 207.

with a garden of pots. The debtor, deprived of personal liberty, and the pauper in the workhouse, divested of all property in external things, and without any fixed object on which to place their affections, sometimes resort to this symbol of territorial appropriation and enjoyment;—so natural it is for all to fancy they have an inherent right in the soil, and so necessary to happiness to exercise the affections, by having some object on which to place them.' *

SECOND WEEK—FRIDAY.

HORTICULTURE.—THE TURNIP.

Among the plants which are cultivated in the garden, as well as in the field, I have elsewhere† described two varieties of the leguminous tribe, the pea and the bean. There is another species of esculent vegetable, some varieties of which are raised by the agriculturist, and others by the gardener. I allude to the turnip, with which I shall begin my selection of horticultural produce.

The native country of this useful bulb has not been distinctly ascertained. Both in France and England, plants of the same species are found in a wild state; but till it be cultivated, it is of little value; and experiments have proved that, in this climate, the indigenous plant cannot, by any mode of culture, be so improved as to be rendered useful. There hangs a mystery, therefore, over the origin of this, as well as several other of our useful cultivated vegetables.

The turnip was familiar to the Romans, and cultivated by them with great care and success. Pliny and Columella agree in considering this esculent as next to corn in utility; and the latter recommends the extended cultivation of it, both as the food of human beings and of cattle. It is supposed that the Roman method of cultivation must have been supe-

* Loudon's Encyclopedia of Gardening, p. 95.

† '*Spring*,' p. 321-325.

rior to that of the moderns, since Pliny relates that some single bulbs weighed as much as forty pounds, a weight double of that obtained by the most skilful modern agriculturist. If this statement can be relied on, it seems to prove something more than mere agricultural skill; for the climate of Italy at present is too warm and dry to be favourable to the growth of this species of produce; and hence it may be fairly inferred, that a considerable change has taken place in the temperature of that country,—a fact, indeed, which is established by more direct proof, as I have elsewhere shown.* It is well known that the turnip attains greatest perfection in regions where the climate is moderately cool and moist. Thus, in the north of England, and in Scotland, the crop is superior to that raised in the more southerly parts of the island. It cannot, however, bear a great degree of cold, and the regions bordering on the Arctic Circle are, on account of the dryness and warmth of their brief summer, and the rigour of the first part of the year, peculiarly unfavourable to its growth. Its successful cultivation, therefore, in the field, seems to be circumscribed to a comparatively narrow boundary towards the north and south; but, as a garden plant, where luxuriant growth is not required, and would indeed injure instead of improving the quality of the plant for culinary purposes, it is far more extensively raised. At Benares, in Hindostan, a latitude of about 26°, turnips, as well as several other northern vegetables, are raised in considerable quantities; and although, in that hot climate, they lose much of their peculiar flavour, are yet eaten with great relish by the European inhabitants.

The turnip is a biennial plant; but it is not permitted to attain to its second year's growth by those who cultivate it merely for food, as it becomes deteriorated in its edible qualities when it begins to produce its seed stalk. After surviving the winter, its large radical leaves having fallen off, a stem shoots up which bears flowers, having the four petals arranged in the form of a cross, and hence called cruciform. The

* 'Spring'—Mitigation of Seasons occasioned by Cultivation.

varieties, both under garden and field culture, are very numerous;* while these again differ with soil and climate, and modes of cultivation. The agriculturist seeks to obtain the greatest quantity of nourishment for his cattle in a given space, and therefore selects those kinds which are at once largest in bulk, and firmest in texture; the gardener, on the contrary, studies flavour and beauty, which he discovers to be incompatible with great size.

As an article of human food, the turnip does not appear to be held in so much request, nor to be prepared in so many ways in our own day, as in former times. In the Philosophical Transactions, we are told that during the occurrence of a dearth in England, in 1629 and 1630, 'very good, white, lasting, and wholesome bread, was made of boiled turnips, deprived of their moisture by pressure, and then kneaded with an equal quantity of wheaten flour. The scarcity of corn in 1693, led the poor of Essex again to have recourse to this species of bread. It could not, we are told, be distinguished by the eye from a wheaten loaf; neither did the smell much betray it, especially when cold.'†

The ancients seem to have excelled in the mode of dressing this vegetable. The 'Curiosities of Literature' record the following amusing anecdote, which shows to what extent the art of gastronomy enabled the cooks of those days to transform this article of food. The king of Bithynia, in some expedition in which he found himself, in the midst of winter,

* In the account of the turnip, published in the Library of Entertaining Knowledge, it is said that ten varieties are in common cultivation, distinguished by colour, size, time of coming to maturity, productiveness, or flavour. Among these the following are particularly noticed:—The Maltese golden turnip, of one uniform orange tinge, perfectly spherical, and of a fine flavour, sometimes introduced with the dessert instead of fruit; the Swedish, a field turnip, the most hardy of any under cultivation, but strong and harsh to human taste; the French turnip, or *naveu*, carrot-shaped, which is much esteemed on the Continent for its flavour; and the Barbary turnip, parsnip-like, with fibrous roots, which is prized for its agreeable pungency.

† Philosophical Transactions, Nos. 90 and 205.

at a great distance from the sea, took a violent longing for a small fish called *aphy*,—a pilchard, a herring, or an anchovy. The longings of monarchs at the head of victorious legions are not to be disregarded. But what was to be done? His cook, who was a master of his art, and fertile in expedients, surmounted the difficulty. He took a turnip, and cut it to a perfect resemblance of the *aphy* in shape. He then 'fried it in oil;' and being 'salted and well powdered with the grains of a dozen black poppies,' his majesty's exquisite taste was so deceived by it, that he 'praised the root to his guest as an excellent fish.'*

Turnips do not contain so much nourishment as some other garden vegetables. Sir Humphry Davy's analysis gives only forty-two parts of nutritive matter in a thousand parts of the common turnip, and sixty-four in a thousand of the Swedish.

I have observed that Pliny's account of the growth of turnips in Italy, seemed to indicate that the soil and climate of that country in his day, was far more favourable for their cultivation than at present exists, not only in that southern latitude, but even in this country. The ordinary weight of a turnip, under British culture, is about six or seven pounds; but in favourable circumstances these bulbs frequently reach as high as sixteen, and in some rare instances, even twenty pounds. It is stated by Mr. Campbell,† that in 1758, a turnip was pulled at Tudenham, in Norfolk, which weighed twenty-nine pounds, and this seems to be the largest on record in modern times. Dr. Desaguliers has made a curious calculation on the rapid increase of the turnip, which affords a remarkable proof of the power of vegetation. One ounce of turnip seed was found by him to contain from fourteen to fifteen thousand single seeds; whence it follows that one seed weighs upwards of a fourteen thousandth part of an ounce; and, comparing this with the weight it acquires in growing, he calculated that, supposing the increase to be

* Curiosities of Literature, vol. v. p. 88.

† Political Survey, vol. ii.

always uniform, it may acquire fifteen times its own weigh in a minute! By an actual experiment made on moss or peat ground, turnips have been found to increase by growth 15,990 times the weight of their seeds each day they stood upon it. 'It is not, however, only the size and weight of the root which renders this crop so productive. The number contained in a given space, with reference to their size, is very great. Some writers speak rather marvellously on this subject; but it is generally thought to be a good crop when a turnip is obtained from each square foot of ground. Mill considers an average crop to be 11,664 roots per acre, which, at six pounds each, will be 69,984 pounds.'*

From these statements we may be enabled to form some estimate of the amazing power which the Creator has put into the hands of man, by subjecting the vegetable world to his skill in the arts of cultivation. The cultivator of the soil may be said to create food for himself and his dependant animals out of the earth. It is not, however, by miracle, but by making a judicious use of the powers impressed on nature by an omnipotent and paternal Hand, that such an effect is produced. This view opens a wide field of contemplation, to which we have already adverted. The varied and peculiar means by which external nature, in all its departments, is adapted to the circumstances of the human race, and calculated to call into action, and give salutary exercise to their powers and faculties, is an exhaustless theme of admiration and gratitude.

SECOND WEEK—SATURDAY.

HORTICULTURE.—BRASSICA, OR CABBAGE.

THE turnip is considered by naturalists as of the *brassica* class, one of the features of which is breadth of leaves, and its young sprouts are often used for culinary purposes, instead of

* Library of Entertaining Knowledge.—*Vegetable Substances*, p. 235.

the common colewort. It is of the varieties which bear the general name of cabbage, that I am now to speak.

Of this vegetable, some kinds have been cultivated from the very earliest times, of which we have any record. Its history, however, is but little known; and as this particular genus of plants is peculiarly liable 'to sport and run into varieties and monstrosities,' it is not probable that we possess it in the same state in which it was used by the ancients. Be this as it may, it is in its present state, as it was among them, a very useful and agreeable addition to our articles of food.

The brassica belongs to the numerous family of the *Cruciferæ*, which furnish great varieties among esculent plants. The roots, the leaves, the stems, and the buds of different species, are eaten raw, or dressed in various ways; and the seeds of many kinds afford a valuable oil. None of the family are directly poisonous. In their fresh state, they either contain a portion of nitrogen ready formed, or have the power of detaching it from the atmosphere, when they begin to undergo decomposition. This quality displays itself sooner in the leaves than in the roots, and to it is owing the very unpleasant odour of the water in which cabbages have been boiled.*

All the kinds of cultivated brassica, the leaves and flowers of which are eaten, belong to the species *oleracia*. This contains many varieties, and almost endless sub-varieties; but they may all be reduced into the three distinctly marked classes of cabbage, kail or colewort, and cauliflower. Of the first, the leaves gather into what is called a head, and are blanched by their own compression; of the second, the leaves are expanded and coloured, with the exception of a small portion in the centre, which encloses the rudiments of the flowering stem; of the third, the flowering stem is short and succulent, the rudiments of the flowers forming into a curd-like head, which does not rise higher than the leaves, and becomes a mass of matter before the corolla or any other part of the flow-

* Library of Entertaining Knowledge, article Vegetable Substances, p. 257.

er is developed. The leaves of the two first kinds, and the curd-like head of the last, are used as food.

It is interesting to know something of the habits and tastes of the ancients in their food, as well as in other particulars; and it may therefore not be thought superfluous to state, that Chrysippus and Dieuches, two physicians, wrote each a book on the properties of the brassica, as well as Pythagoras and Cato, all of whom, and especially the latter, recommend it as a most valuable culinary plant. Pliny mentions it as 'in great request in the kitchen, and among riotous gluttons,' alluding, probably, by the latter expression, to the quality it was supposed to possess of restoring the tone of the stomach after deep potations. The same author, in speaking of the spring sprouts of colewort, says, 'Pleasant and sweet as these crops are thought by other men, yet Apicius, that notable glutton, loathed them; and by his example, Drusus Cæsar held them in no estimation, but thought them a base and homely food; for which nice and dainty tooth of his, he was well checked and reproved by his father Tiberius the Emperor.'

This ancient naturalist gives directions for the cultivation of brassica, which may also be stated. 'If you would have very fine plants,' says he, 'both for sweet taste and great produce, first let the seed be sown in ground thoroughly dug over more than once or twice, and well manured; secondly, you must cut off the tender young stalks, that seem to put out far from the ground, and such as run too high; thirdly, you must raise mould or manure up to them, so that there may be no more above the ground than the very top.'—'There are,' continues he, 'many kinds of brassica in Rome, such as that of Cumes, which bears leaves spreading flat along the ground, and opening in the head; those of Aricia, which are tall and send forth numerous shoots; and the colewort Pompeianum, so called from the town Pompeii, which also grows high, and sends out many tender sprouts.'* Referring to the Aricia

* Pliny also mentions the brassica of Calabria, remarkable for its large leaves, small stalks, and acrid taste; and the Sabellian brassica with curled

plants, he afterwards adds, 'It is not long since we have procured a kind of cabbage-cole from the vale of Aricia, with an exceedingly large head, and an infinite number of leaves which gather round and close together.' He further speaks of some coles which assumed a round shape, others which extended in breadth, and were very full of fleshy fibres; and others again which bore a head twelve inches thick, and yet none put forth more tender buds.

In some of these descriptions we recognize a very distinct resemblance to several kinds still in existence, with such differences as might be expected to exist at such a distance of time in an order of vegetables, the pollen of which so freely intermingles with the seeds of others of the same genus, producing new species. It is not uninteresting to observe both the agreements and the differences subsisting between ancient and modern horticulture; and it is especially pleasant to remark among horticulturists of former days, the same kind of eagerness to obtain and give publicity to new varieties, which prevails at present.

Many fanciful notions were, in the classical ages, entertained of the medicinal qualities of brassica. Both the Greeks and Romans used its juice, with honey, as an eye-salve; they mixed it with goats' milk, salt, and honey, for the cramp; they took it inwardly, as a remedy against poisonous mushrooms, as a purifier of the blood, and a clarifier of the brain after intoxication. The plant was prepared as a liniment to assuage swellings of the glands, and to restore blackened bruises to their natural colour; they bruised it raw, with vinegar, honey, rue, mint, and the roots of laser, as a cure for the headache, the gout, and many other complaints; they recommended it to mothers, who were nurses; they even prescribed it for the palsy, for tremblings of the limbs, from whatever cause, and for vomiting of blood.*

Of the cabbage, properly so called, a preparation is made by

and ruffled leaves, a small stem, and a head of wonderful size, which latter was much esteemed for its sweetness.

* Philips on Cultivated Vegetables—article Cabbage.

the process of fermentation, which the Germans, who are im moderately fond of it, call *Sauerkraut.* The manufacture of this article of food is carried to a great extent by the Tyrolese, among whom it forms a separate profession. 'October and November are the busy months for the work, and huge white pyramids of cabbage are then seen crowding the markets; while, in every court and yard, into which an accidental peep is obtained, all is bustle and activity in the concocting of this national food; and the baskets, piled with studded cabbage, resemble "mountains of green-tinged froth or syllabub."'* This preparation has been found to be of sovereign efficacy as a preservative from scurvy during long voyages. It was for many years used in our navy for this purpose, until displaced by lemon-juice, which is equally a specific, while it is not so bulky an article for store.

A variety of brassica, under the name of cow-cabbage, has been recently introduced into this country, from La Vendee, by the Comte de Puysage. The proximity of this department to the ancient province of Anjou, and the description of the plant, leave no doubt of its identity with the Anjou cabbage,—a very large variety described by Mill.† In 1827, thirty-six seeds were, according to the Gardener's Magazine, divided among six agriculturists, for the purpose of raising this useful vegetable in England. The perfect success resulting from some of these seeds, which have produced plants of luxuriant growth, is already known; and very recently the speculation of a spirited individual, has rapidly diffused it over the kingdom, so that there is every reason to hope, that the cow-cabbage will immediately come into extensive cultivation in Great Britain. It is said that sixty plants afford provender sufficient for one cow, during three or four years, without fresh planting. A square of sixty feet will contain 256 plants, four feet apart, which are sixteen plants more than four cows require for a year's provender, without the aid of other food. Were we to give way to the anticipations, which this and similar facts might excite, of the powers inherent in esculent

* Vegetable Substances, p. 263. † Mill's Husbandry, vol. iii.

vegetables that yet remain to be developed by the skill and industry of man, views might be unfolded of the future population of the globe, almost too magnificent for the imagination to follow. There are, however, too many counteracting circumstances in the present state of society, to permit a man of judgment, chastened by experience, to indulge these views without abatement.

One important reflection, indeed, which I have not elsewhere overlooked,* again presses itself on our notice. Such facts only form a branch of a great department of natural phenomena, which prove that energies are impressed on creation, lying, as it were, in abeyance and reserve, till the ingenuity of man shall call them into action. Thus, in the present and similar instances, the inconveniences arising from the superabundant power of *animal* reproduction are in continual course of mitigation, by the interference of man in stimulating the superabundant power of *vegetable* reproduction; and as human society advances in knowledge and civilization, the number of mankind, and that of living beings destined for their use, is increased, and their welfare provided for; while, by the enlarged resources so acquired, the human faculties find room to expand, and those ulterior intentions of the universal Parent are urged forward, of which revealed religion has opened so glorious a prospect.

THIRD WEEK—SUNDAY.

SPIRITUAL LIGHT.

The analogy between the light of the sun, and that moral illumination which is shed on the soul by Him who is emphatically called 'the Light of the World,' is very frequently alluded to in Scripture; and the splendour which now shines around us naturally raises our thoughts to this animating subject.

* See '*Spring*,' pp. 36, 38.

There are various interesting views in which this analogy presents itself. Sometimes it is employed to illustrate the progressive nature of religion in the soul, as when it is said, 'the path of the just is as the shining light, which shineth more and more unto the perfect day.' This comparison is at once apt and beautiful. First on the dark bosom of night the day star appears; then breaks forth the lovely dawn, shedding over the face of heaven and earth a faint, but grateful and increasing, light. At length opens the bright eye of day, and the broad and deep shadows of morning mingle and are contrasted with the lustre of the new born rays. Higher and higher the sun takes his course in the heavens, till hill and valley, wood and stream, glow as he shines; till the shadows soften and are diminished, and till all Nature rejoices in the universal blaze. And so it is with the Christian. In the morning of his spiritual day, how faint is the light of his graces, how broad and deep the shades of his remaining ignorance and sin! But as the day advances, his illumination and fervour increase; the dark shadows of his character become less conspicuous; they are contracted in their dimensions, and mitigated in their intensity, till one by one they disappear; or by the contrast, only show his virtues and graces more bright. It is thus that he approaches his noon; but, alas! he attains it not in this sublunary state. Clouds intervene and storms lower, and before all that is dark in his character is removed, he suffers the eclipse of the grave; only, however, to shine forth as the sun in the kingdom of his Father.

As the progress of the day may be applied to illustrate the advancement of an individual in christian truth and religious practice, so the progress of the year may be taken as shadowing forth the gradual, but constantly progressive state of the christian community. This movement is not always in unison with the advancement of society in the arts and sciences; but, on the contrary, as history and experience abundantly prove, frequently takes an opposite direction. The light of reason and the light of revelation, although they are derived

from the same source, and when combined, shed an intenser glory over both the world of nature and the world of grace, are yet, by the perverseness of fallen man, sometimes practically contrasted, and caused to obscure each other. Human wisdom is essentially worldly; and, unless sanctified by the wisdom which cometh from above, it shines with its own meteor light, and is the rival, not the auxiliary, of the Sun of Righteousness. Yet in its own sphere, even then, its powers are wonderful. Within the two last centuries, it may be said to have advanced from spring to summer, and in our own day has produced fruits which have astonished the world. The inventions to which it has given rise, are rapidly changing the face of society and the common relations of life, and seem destined not to stop till they shall have effected a complete revolution in the character and condition of the human race. Under the operation of this principle, knowledge is pouring in on the ignorant, learning becomes more learned, skill more skilful, and ingenuity more ingenious. Industry finds new paths to wealth; luxury new means of gratification; philosophy new departments of study; commerce new and more ample resources. By unheard of means, human intercourse becomes daily more easy and rapid; and mankind, brought closer together, are united by new ties. To the genius, the talent, and the enterprise of man, who will venture to fix limits?

But look more attentively, and you will find that all these productions of human talent and industry, when unblest by the enlightening and vivifying power of religion, carry in themselves the seeds of their own destruction, and must end in the blight and desolation of winter. The spirit by which the present generation is actuated is selfish, restless, and worldly. In the bustle of life, individual struggles against individual, class against class, interest against interest; while all are fearfully affected by an increasing relaxation of moral and social ties. What is become of those patriarchal feelings which led the higher ranks of society to regard their dependants as members of their own family? Where is that affec-

tionate deference and regard which, in the days of our fathers, graced the intercourse of the poor with the rich? While luxury and dissipation enervate the faculties, and injure the character of the one class, unsanctified knowledge is giving power, and extensive combinations an ominous influence, to the other. To crown all, a reckless disregard of all that is venerable in ancient institutions, and sacred in principle, rises and prevails. The bands of society seem even now ready to burst asunder, and threaten, at no distant period, to desolate the world with blood. If the crisis be not averted, who dare say that science, with its boasted light, shall not be extinguished, and the darkness of ignorance and barbarism again brood over these christian lands!

But there is one remedy,—there is only one. That remedy does not consist in arresting the progress of knowledge; which would be altogether undesirable if it were possible, and impossible if it were desirable. It consists in enlightening that knowledge, by bringing it under the influence and illumination of Him, whose advent was announced as that of 'a light to lighten the Gentiles.'

In looking to the future destiny of the human race, it is an unspeakable satisfaction to be assured, by that Oracle which cannot lie, that the time will come, and is now in progress, when the earth shall be filled with the knowledge of the Lord; and when the Sun of Righteousness shall shed the glories of His rays over the whole world. I shall not pretend to fix the period of this blessed era, or dare to pry into 'the times and seasons which God has put in his own power.' But one thing is certain,—whenever that blessed period arrives, the lights of reason and revelation will unite their rays, and it shall be made manifest, that even worldly ingenuity (though it meant not so), has been preparing its discoveries, and elaborating its inventions, to add to the comfort and happiness of the children of the Redeemer. Then science will bestow its knowledge to elevate the devotion of saints, and commerce will give its ships and its engines to facilitate their intercourse; and all the necessaries and conveniences

which civilization shall have accumulated, will be employed to fill their hearts with gratitude to the Giver of all good. Then education will open its schools to teach the wonderful things of God; and learning will yield its libraries, and art its stores, to feed the soul with knowledge, and enlarge its powers. Then all things will be sanctified by being employed to promote the glory of God and the good of men; and it will be felt and acknowledged that genius has not laboured, nor science advanced, in vain. Thus shall Providence be vindicated in his dealings with the human race, and all shall be well.

THIRD WEEK—MONDAY.

HORTICULTURE.—VARIOUS GARDEN VEGETABLES.

It would not be consistent with the object of this work, to enter much further into a description of the individual plants, which form the produce of the kitchen-garden. The specimens already given, serve to show, in two different species, the provision which the Creator has made for the supply of wholesome varieties of food, that may be rendered, by the arts of cultivation, exceedingly prolific, and seem thus destined to add to those resources, by which field and garden labour shall continue, to a period and extent not easily calculated, to satisfy the wants of a rapidly increasing population, and by such means to increase most materially the numbers of living beings, and especially of the human species, on the surface of the globe.

What, before leaving this department of our subject, remains chiefly to be shown, is the great variety of esculent vegetables, in point of quality and flavour, as well as mode of growth, which it has pleased the Creator to place in the hands of the horticulturist. In reference to the latter, there is no part of a plant which we do not find, in some particular species, fit for food. The root, the bulb, the stalk, the leaf,

the flower, the seed, each in its turn, is gifted with those qualities, which render it a valuable and agreeable materia. for culinary purposes. Some of these varieties have already been noticed;—as an instance of edible seeds, I have mentioned the pea and the bean; of edible leaves, the cabbage; of edible flowers, the cauliflower; of edible bulbs, the turnip; of edible roots, the potato:—but of all these there are other kinds, to some of which I shall now shortly advert.

Among roots may be particularized, the carrot, the parsnip, the beet, the skerret, and the scorzonera. The two latter are now almost excluded from the list of vegetables cultivated in the gardens of this country, having been superseded by the more favourite varieties which the others afford, although the scorzonera is a particularly delicate kind of food, and might with advantage be retained. The carrot and parsnip are found wild in this country; but the experiments which have been made on these native plants have not succeeded in rendering them fit for garden culture; and, like many other of our vegetable productions, they seem to have required a more genial climate for the development of their esculent qualities; although, when once developed, these are retained without degenerating under the ordinary routine of our gardens. The carrot is particularly prized as an agreeable variety at our tables, and, in some parts of the country, it is even extensively grown in the field for the consumption of stock, and, in various instances, with great advantage. Take the following example:—'At Partington, in Yorkshire, the stock of a farm, consisting of twenty working horses, four bullocks, and six milch cows, were fed, from the end of September to the beginning of May, on the carrots produced from three acres of land. The animals, during the whole of that period, lived on these roots, with the addition of only a very small quantity of hay; and thirty hogs were fattened on the refuse left by the cattle.'* The nutritive qualities of carrots and parsnips are found to be nearly equal, the former containing 98, and the latter 99, parts

* Library of Entertaining Knowledge, Vegetable Substances, p. 244.

of nutritious matter in 1000, of which there are in the carrot 3, and in the parsnip 9, parts of mucilage, the rest being saccharine substance.

The beet, according to Sir Humphrey Davy's analysis, contains more nutritive matter than any other root, excepting the potato, the quantity being 148 parts in 1000, or nearly 15 per cent., of which about 12 per cent. is saccharine matter. This large proportion of the latter substance has led to various experiments for its employment in the production of sugar, which has ended in the establishment of this manufacture in France, by the imposition of excessive duties on the importation of sugar from the colonies—a public act of more than doubtful policy.*

Examples of garden herbs, which, like the brassica species, supply varieties of vegetable food in their leaves, are to be found in the spinach and lettuce. The former takes its name from its Moorish appellation, *Hispanach*, or Spanish plant, having been first brought into Europe through the medium of Spain, probably from the west of Asia, where it was early famous for its supposed medicinal qualities. Spinach is an annual plant, having large and succulent leaves. It is chiefly remarkable in botany as being one of that class of vegetables, which has the different parts of fructification on separate plants —hence named *diœcious*. There is a species of spinach, indigenous in this country, called, somewhat fantastically, Good King Harry, or English Mercury. It is a perennial, and has large arrow-shaped leaves, powdered on the under side. The stem is also powdered, and is upright, thick, and striated. When young, both the stem and the leaves are succulent, the former being used as an asparagus, and the latter as a spinach. It is cultivated in Lincolnshire, where it is preferred to common spinach; but it does not easily accommodate itself

* 'The cultivation of the beet,' truly observes the Quarterly Journal of Agriculture, 'is but one ramification of that system of repulsion and exclusion, which has been adopted in France, to the oppression of her domestic industry, the ruin of her foreign commerce, and the maintenance of false principles in the commercial policy of surrounding nations.'—No. xii.

to differences of soil and situation. This probably arises from the circumstance of its having been only recently brought into a state of cultivation ; for it is worthy of remark, that, among other advantageous changes produced in the character of plants, that of superior docility, as it may be called, is acquired by long subjection to training.

Lettuce is used in its raw state with the dessert, made up with other garden herbs into a salad, and is of so easy growth, and so cooling and agreeable in its qualities, as to be an universal favourite in the gardens even of the middle classes. The species comprises many varieties, all of which possess a milky juice, which is slightly narcotic. This juice is very bitter, and, when it becomes abundant, which takes place as the plant advances towards the period of flowering, it ceases to be used at the table. Of late, the narcotic principle of the lettuce has been employed in medicine, under the name of *lactucarium ;* and it is believed to possess the virtues of opium, in a mild degree, without producing the same deleterious effects. It has, in some places, become an object of culture for this particular object.

The endive, a native of China, and the succory or wild endive, which is indigenous in Britain and throughout Europe, are employed also as salads, and afford other instances of plants being propagated for their edible leaves.

Of the productions of the garden which have esculent bulbs, the onion is the most remarkable. It is not very nourishing, nor agreeable in its odour, but it possesses a pleasant pungency of taste, which renders it very acceptable, especially to the humbler classes, who use it as the chief relish for their food. This bulb has been an object of cultivation for at least 4000 years. We read in Scripture of the highly-prized onions of Egypt, where the plant is still a favourite article of food. Hasselquist speaks of the Egyptian onion as one of the greatest delicacies in the world, and says, ' there is no wonder that the Israelites regretted its loss, and wished to return to servitude, that they might enjoy it !' In this country the comparative coldness of the climate has caused the onion to degener-

ate, rendering its flavour rank, and its coats too compact to be easy of digestion.

Among garden plants, the shoots of which are used at the table, I may particularize the asparagus and the celery, the top of the former being eaten, and the blanched lower parts of the footstalks of the latter. They are employed entirely as a luxury, and appear only at the tables of the middle and higher classes. The former was cultivated by the ancients, and was held in much esteem in the classic ages. 'The head of the young shoot of asparagus is edible just as far as the part that is to flower extends; and thus, one who eats a head of asparagus eats, in that little space, the rudiments of many hundreds of branches, and many thousands of leaves.'*

I shall not extend this enumeration farther. My object has been accomplished, so far as relates to the variety of forms in which the Author of Nature has produced esculent vegetables, although but a very small part of that variety has been noticed. What are still more worthy of observation, as indicating benevolent design, are the differences which exist in the taste and flavour of these productions. In this particular, they all vary from each other. Each produces its own peculiar excitement on the organs of taste, and thus gives rise to very many agreeable sensations. Our great Milton has thought it not beneath the epic dignity of his sublime poem, to represent the mother of mankind selecting and arranging, with the nicest regard to their various and peculiar tastes, the fruits which she prepares as a banquet for her angel guest. The poet had too much fine philosophy not to discern the blessing conveyed in the wonderful variety of tastes possessed by the earth's vegetable productions; and, accordingly, he thus alludes to it in his own inimitable manner:—

'So saying, with dispatchful looks, in haste
She turns on hospitable thoughts intent;
What choice to choose for delicacy best,
What order, so contrived as not to mix

* Vegetable Substances, p. 276.

Tastes not well joined, inelegant, but bring
Taste after taste, upheld with kindliest change;
Bestirs her then, and from each tender stalk,
Whatever Earth, all bearing mother, yields
In India, East or West, or middle shore,
In Pontus or the Punic coast, or where
Alcinous reigned, fruit of all kinds, in coat
Rough, or smooth rind, or bearded husk, or shell,
She gathers tribute large, and on the board
Heaps with unsparing hand.'

The pleasures resulting from the gratification of the senses are indeed of inferior value; but yet, in estimating the blessings which our heavenly Father has scattered around us, they are not to be overlooked. Like every other gift, they may doubtless be abused, and there is nothing more disgusting than the character of a glutton or an epicure. But, when kept in their proper place, they not only add to the charm of existence, but in many ways form a salutary stimulus to exertion, and produce a useful moral effect on the human character.

THIRD WEEK—TUESDAY.

HORTICULTURE.—FLOWERS—THE ROSE.

Since the culture of flowers became an object of care and attention in this country, their varieties have been much increased. The old world and the new have poured their treasures into British gardens, the green-house is enriched with a brilliant crowd of exotics, and the more hardy natives of distant climes flourish among the kindred beauties of our soil. But our own woods and brakes have supplied the principal decorations of the parterre, and it is to the practical gardener a source of the liveliest interest to beautify the wild flower by skilful management. The little blossoms of the woods and fields, springing from the parent earth, and nourished by the sun and dew, without the aid of human art, have a grace and simplicity peculiar to themselves; they seem the especial pro-

perty of those who pause to search them out from their mossy beds and hiding-places among the grass,—and who have the taste to admire in each the perfection of structure that marks it as a production of Divine wisdom. The elegance of these wildings appear to indicate that they are designed to soften and refine the mind of man.

> 'The gentle flowers,
> Retired and stooping through the wilderness,
> Talk of humility, and peace, and love,—'

and happy is he who has learned to listen to their voice. They are plentifully scattered among the 'thorns and thistles' of the wilderness to mitigate the curse brought on the earth by sin. These are as the lingering relics of the garden of Eden, rich in spontaneous flowers,

> 'Which not nice art
> In beds and curious knots, but nature boon
> Pour'd forth profuse on hill, and dale, and plain.'

But our woodland favourites may be transformed by cultivation into the noblest flowers, and we recognize them in the garden under a more imposing form, and emitting odours to which many of them were strangers before. The hearts-ease of the woods and mossy banks becomes the bright and perfumed violet and pansy in all their varied and beauteous families. The oxlip assumes the different sizes and colours of the polyanthus; and the butter-cup, that 'gem of the field,' is discovered in the dazzling varieties of the ranunculus.

Summer is the season of flowers; the earlier kinds which adorn the Spring, have given place to a brilliant succession, opening in the genial heat of the sun. The eye wanders from one to another, comparing, and contrasting, till individual loveliness is lost in the splendid whole. The far-spreading mignionette fills the air with fragrance. The aromatic carnation rises beside the delicate convolvolus, and the iris and the amaranth vie in the brightness of their colouring. But to describe, or even to enumerate the whole would be work for a volume; we shall therefore confine ourselves to the rose,

which opens its blossoms from the regions of the sun to the wintry north, and is universally acknowledged as

> 'The pride of plants, the grace of bowers,
> The blush of meads, the eye of flowers.'

There are between three and four hundred varieties of the rose, all bearing the same general characteristics amid their diversity of size, hue, and fragrance. The dog-rose, with its five petals and pitcher-shaped calyx, is the pride of our hedge-rows. Its flowers hang in wreaths along the way-side, or decorate the rustic fence around the cottage garden. The bright scarlet hips shining among the naked boughs in winter, form the food of pheasants and other birds, and a conserve is made of the pulp beaten with sugar. The sweet-briar rose resembles this, enlivening the sober green of the woods and hedges with a profusion of red, white, and blush coloured flowers, and clothing with beauty and verdure those gravelly tracts where less hardy flowers refuse to grow. It is, like the best blessings of mankind, common to all; and we question whether it has been more enjoyed by the poets who have sung the 'dew-sweet eglantine,' or by the peasant, whose toils have been beguiled by the fragrance of its green leaves, which is among the sweetest of all that scent the morning breeze. The swelling forms of the garden roses, as they burst from the sheltering calyx, present a striking contrast to these. There are the hundred-leaved, including the delicious cabbage rose, the white Provence, and several other varieties. How inexhaustible are the riches of a single bush! The bud expanding to supply the place of the flower that strews its petals on the earth, leaves us scarcely time to regret its loss, or to feel that a charm is gone. The exuberant flowers adorn the whole summer, and diminish by slow degrees as the autumn advances, as if unwilling to leave the parent stem to cold sterility. What can exceed the beauty of the rose on a summer morning, half-blown, and bathed in dews that shine red in the early sunbeam, as it reflects on them the hues of the folded petals!

'Ah! see deep blushing in her green recess
The bashful virgin rose, that half revealing,
And half within herself, herself concealing,
Is lovelier for her hidden loveliness.'

The English rose, the symbol of royalty, is of a rich crimson hue, and large, but not very double. This is the

'Flower which of Adon's blood
Sprang, while from that clear flood
Which Venus wept, another white was born.'

This white rose, graceful as is its tall stems laden with innumerable flowers, is rivalled by the rose of Scotland, low of stature, and delicately beautiful, spreading in the shade its modest boughs, covered with a shower of small sweet blossoms, as thick as the snow-flakes of winter.

The yellow rose, which is a native of Italy and the south of France, is comparatively rare in this country, as is the Austrian rose, which is sulphur-coloured on the outside, and scarlet within. The double yellow, which grows wild along the shores of the Levant, is shy of blooming in England, and seldom shows its full and ample flowers in perfection above once in a lifetime.

The rose was among the tasteful Greeks esteemed the first of flowers; nor can any lover of antiquity be indifferent to the sacred flower of the Muses, blooming on the mountain of Pieria. The China rose continues to flourish in winter, when others are faded; and our windows are graced by that which the Romans were at great expense to procure, and for which Nero did not scruple to give £30,000, to decorate one magnificent supper.

The rose grows in the cold clime of Northern Lapland,—

'Where pure Niemis' fairy mountains rise,
And fringed with roses, Tenglis rolls his stream.'

But in the sunny plains of Persia it attains to its greatest perfection, and the inhabitants of that land consider it especially their own. They call it by many names, and not only are heir gardens filled with it, but their apartments and baths are

continually strewed with its ever-opening flowers; and they celebrate its beauties in the Feast of Roses, which is not wholly discontinued as long as it is in bloom. In Persia, the rose-bush sometimes attains the height of fourteen feet. There, too, the air is vocal with the songs of the nightingale, as he warbles where

> 'His queen, the garden queen, the rose,
> Unbent by winds, unchilled by snows,
> Far from the winters of the west,
> By every breeze and season blest,
> Returns the sweets by Nature given
> In softest incense back to heaven;
> And grateful yields that smiling sky
> Her fairest bloom, and fragrant sigh.'

The rose bears a conspicuous part in the gorgeous poetry of the East, furnishing similes and allusions as numerous as its own flowers. It has been the subject of many fictions and allegories, whose fanciful beauty we might admire, but that they have assisted in leading the darkened mind away from Him whose beneficence has caused roses to spring up over the earth. The German fable of the origin of the moss-rose is well known. The angel of the flowers, awaking from his slumbers beneath the shade of a rose-bush, offered to bestow whatever it required, and when it asked for another grace, he threw around the flower a veil of moss. There is also a legend of Palestine which ascribes the origin of the rose itself to the unjust condemnation of a holy maiden, whose pile, when the torch was applied, became in a moment bright with innumerable roses, the first that had blossomed out of the precincts of the garden of Eden. With these the people, it is said, triumphantly wreathed her head, as they conducted her to her home. The name of Syria has been supposed to be derived from *suri*, a species of rose to whose superiority Virgil bears testimony, when, in describing an era of universal happiness, he says,

> 'Each common bush shall Syrian roses bear.'

In Judea, blighted and forsaken as she is for the sin of her

children, there still are 'vallies of their roses voluntarily plentiful.' The moral desolation, alas! is more complete, and the land has long sighed for the return of the days when her 'Rose of Sharon' shall again be an emblem of the more excellent beauty of the Bride, the Church, and when, in the awakening of multitudes to the faith of the Redeemer, 'the desert shall rejoice and blossom as the rose.'

The custom of strewing flowers around the dead, is probably of a date as ancient as the affection that seeks to associate all that is best and sweetest with those for whom it weeps. The Turks, the Spaniards, and the French, with all their dissimilarities, agree in this; the exalted and the humble have alike gathered roses to scatter around the departed Milton invokes the musk-rose

'To strew the fragrant hearse where Lycid lies;'

and the peasantry of South Wales vie with each other in planting the graves of their friends with memorial-flowers.

Flowers are not of very general use as food for insects, but the rose-beetle banquets on that after which it is named; the carpenter-bee cuts round patches from the green leaves of the bush to line its nest; and on the rose the butterfly basks in the sunshine, feasting on the nectar it contains.

The crimson rose was much valued by the Arabian physicians; the hundred-leaved also is used for infusions and syrups; and from the pericarp of the Scotch rose, a peach-coloured dye is obtained. Fragrant as are the waters distilled from our garden roses, that derived from the eglantine is by many esteemed still more so. The famed rose-water of Egypt is drawn from the white rose, which is extensively cultivated for the purpose. But more costly, and still more intensely sweet is the ottar of roses, which is imported from Egypt and the East Indies. To produce it, a cask filled with rose-leaves and water is set in the sun for a few days, when a number of oily particles rise to the surface; these are gradually collected into a scum, which is taken up by means of a little cotton, and squeezed into a phial. It is said that not above

half an ounce of this precious perfume can be extracted from 100 lbs. weight of roses. M. L. D.

THIRD WEEK—WEDNESDAY.

HORTICULTURE.—FRUITS.

Fruits come next to be noticed, and for the facts relating to their history, I am indebted to the learned and judicious notices contained in the preliminary observations to the detailed account of the productions of the orchard, published by the Society for the Diffusion of Useful Knowledge.*

The progressive cultivation of fruits, as well as of other vegetable productions, and their removal by wandering tribes of conquerors, from region to region, give, when these events can be traced, a peculiar interest to the subject. The absence of records, and the little attention which early history has paid to almost any thing save the splendid though destructive tracks of victorious armies, have involved the facts in obscurity; but, wherever man has penetrated, we may be assured that he has assisted in the dissemination of vegetable productions, 'much more surely and rapidly than the birds which bear their seeds from land to land, than the currents of the ocean, or even than the winds.'

If we consider, for example, the fruits o our own country, we shall observe to what extent the conquests of foreign foes have operated in this beneficial manner. Before the invasion of the Romans, the natives of Britain probably possessed no other than the wild fruits of northern Europe, the crab, the sloe, the hazel-nut, and the acorn. The Romans themselves had, but a few centuries before, obtained their principal fruits from Greece, and more eastern countries. It was not till the triumph of Lucullus, that the cherry was transported to Italy

* Vegetable Substances, pp. 213–222.

from Pontus,* as a memorial of his conquest. In less than a century, the same species of cherry was common in France, in Germany, and in Britain, where the conquerors had introduced it. Thus the cherry, and in all probability, the peach, the plum, the apple, and the pear, are evidences that Britain was once a province of Rome. It is interesting to remark, as a fact in perfect accordance with the ordinary operations of the allwise, but mysterious Governor, who 'causes the wrath of man to praise him,' that the evils of war are generally mitigated, in the earlier stages of society, by the diffusion of the arts of cultivation. Plutarch, noticing this in the case of Alexander the Great, says, perhaps with some natural exaggeration, that the communications which that conqueror opened up between distant nations, by his progress into India, had more benefited mankind than all the speculative philosophers of Greece. This incidental blessing, however, is only confined to the early ages of the world; and war becomes an unmitigated evil when mankind have advanced in civilization,—an evil, however, to which that very civilization tends to put an end by distinctly exhibiting it in this light.

Another and milder sway introduced new fruits into Great Britain: I mean that of the church. The Monks, after the conversion of the Anglo-Saxons to Christianity, appear to have been the only gardeners; and, in the agreeable relaxations of this profession, they took great delight. While the rude nobles and barons, and their still ruder dependants, wasted each other by mutual depredations, the sacred ground of the church was universally respected; and there the gentle arts of peace found shelter, and were successfully pursued. The venerable Abbey is almost always found situated in some spot remarkable for its fertility, as well as for the beauty of the surrounding scenery. 'Even though it has

* From Cerasus, a Greek city on the shores of the Pontus Euxinus, cherries were first brought to Europe by the Roman conqueror in the year of Rome 680, that is, before the Christian era 73: and from the name of this place our word *cherry* is supposed to be derived.

been wholly neglected, though its walls be in ruins, covered with stone-crop and wallflower, and its area produce but the rankest weeds, there are still the remains of the aged fruit-trees, the venerable pears, the delicate little apples, and the luscious black cherries. The chestnuts and walnuts may have yielded to the axe, and the fig-trees and vines died away, but sometimes the mulberry is left, and the strawberry and raspberry struggle among the ruins.'

The Crusades, by renewing a communication with the countries of the East, again assisted the diffusion of those vegetable treasures which had been neglected after the destruction of the Roman empire. The monastic gardens owed many of their choicest fruits to the care of those ecclesiastics who had accompanied the expeditions to the Holy Land. A similar result of this taste for horticulture, which existed in European monasteries, seems to have accompanied the transplantation of this corrupted form of Christianity into the new world. 'In studying the history of the conquest,' says Humboldt, 'we admire the extraordinary rapidity with which the Spaniards of the sixteenth century spread the cultivation of European vegetables along the ridge of the Cordilleras, from one extremity of the continent to the other;' and he attributes this remarkable effect principally to the industry and taste of the religious missionaries. In the South Seas, in Southern Africa, and in Australia, the same system is now pursued; in the two former places, chiefly by missionaries; in the latter, by the free settlers. With regard to Australia, in particular, the introduction of European fruits, and other vegetable productions, was essential to the subsistence and comfort of the inhabitants; for, previous to its occupation by the British, there was scarcely a production of the soil fit for human food; and it is remarkable that the only addition which has been made to the list of our garden vegetables, by the discovery of that new and singular continent, is a species of spinach.

It was not till the age of Queen Elizabeth, that horticulture made much progress among the middle classes. Com-

merce began at that era to diffuse its wealth, as well as its intelligence and enterprise; and then horticulture may be said to have first exercised its beneficial influences among the mass of the people. In 1596, Gerard published a catalogue of eleven hundred plants, growing in his garden in Holborn, the fruit of much industry and zeal; and, in the reign of Charles I. (1629), Parkinson, who may be considered as the Bacon of Horticulture, published his great work. From this period, the science of gardening went hand in hand with commerce and the arts, till it has arrived at its present advanced state. It is still, however, very far from having reached its climax, either in this or any other country. When we reflect, indeed, on the manner in which the powers of nature yield to the hand of the cultivator, and the amazing discoveries which are almost yearly made, of new and more successful methods of drawing forth her latent energies, we are almost tempted to think that the art of gardening is yet in its infancy. The President of the Horticultural Society, which was founded in 1805, by the exertions of Sir Joseph Banks, and other spirited individuals, thus strikingly expresses himself, in his introductory remarks to the first volume of its Transactions:—'The austere crab of our woods has been converted into the golden pippin, and the numerous varieties of the plum can boast no other parent than our native sloe. Yet few experiments have been made, the object of which has been productions of this sort; and almost every ameliorated variety of fruit appears to have been the offspring of accident, or of culture applied to other purposes. We may, therefore, infer, with little danger of error, that an ample and unexplored field for future discovery and improvement lies before us, in which nature does not appear to have fixed any limits to the success of our labours, if properly applied.'

THIRD WEEK—THURSDAY.

HORTICULTURE.—ENGRAFTING.

If my readers remember what has been said on the nature of the sap,—its circulation, secretion, and aëration, they will be prepared to understand the principle on which the success of engrafting depends. The sap, it will be remembered, which is the food of vegetables, is nearly the same, as to its chemical properties, in most plants; it is collected from the common soil by the roots, and is transmitted by the vital principle, with the aid of capillary attraction, through every part of the plant; in the buds and leaves, it undergoes its first and great change, being there converted into the proper juice, or, in other words, assimilated to the nature, and rendered fit for the development, of the vegetable to which these leaves belong; and, returning from thence, undergoes all the other operations which the conformation and health of the plant require.

It seems obvious, from this account, that all which is necessary for preserving the vital principle, and developing the peculiar properties of any part of a plant, is, that it should be placed in such circumstances, as that the sap, from a root, may be readily transmitted through it, to a bud or leaf. Now this is precisely what is done in the process of grafting. The engrafter takes a scion, or branch, of the tree which he wishes to propagate, and, having cut off the top from the growing stock which he intends to convert, he applies the inner bark of the one to that of the other, and binds them firmly in this situation. There are various methods of effecting this, which I shall not attempt to detail; it is enough to know, that if the operation be dexterously performed, and the two trees be of so similar a quality in their cellular texture, as to present no material obstacle to the flowing of the sap, the graft will retain its living principle, the necessary circulation will be completed, the buds of the inserted branch will expand into leaves,

and in virtue of the law already mentioned, these leaves will secrete the 'proper juice' of the vegetable production to which the scion belongs, and will grow into a tree of the same species and variety, bearing fruit precisely of the same kind as the parent plant from which it was taken.

There are some niceties in the operation, which are of importance to its success, and the nature of which confirm the view I have now taken. In what is called tongue-grafting, for example, it is desirable that the top of the stock, and the extremity of the graft to be applied to it, should be nearly of equal diameter; and both must be cut off obliquely at corresponding angles. A slip, or angular opening, is made in the centre of the stock downwards, and a similar slip in the graft upwards, into the former of which the thin point of the upper half of the sloping end of the graft is inserted; the barks of stock and graft are made closely to unite, and are tied firmly together by means of strands of bass-matting, soaked in water, to exclude the external air; a quantity of clay is then applied over all, which had been worked fine, and mixed with small chopped hay or horse-droppings; or a composition is applied, of turpentine, bees-wax, and rosin. By these means an intimate union is formed between the graft and the stock, and the flow of the sap, both upward through the cellular texture of the plants, and back again through the inner bark, is facilitated.

Budding, which is also frequently resorted to, is an operation of a similar kind, and depending on a similar principle, the only difference between a bud and a graft being, that the former is a shoot in embryo, the latter a shoot fully developed. This is a summer, or autumnal process, being performed from the beginning of July to the middle of August, when the buds for next year are completely formed in the axilla of the leaf of the present year.

The chief object of engrafting is to insure fruit, or other productions of some selected variety. This is particularly important in fruit-trees, the varieties of which, raised from the seed, being very numerous, and by far the greater pro-

portion of which producing crabs, or fruit not esteemed for the table. By this ingenious device, the peculiarities of the vegetative process are subjected to the control of man, and made subservient to his comfort; and it is assuredly not too much to say, that these peculiarities were so contrived by the Author of Nature, as to afford, in this respect, a salutary exercise to human ingenuity.

I shall have occasion again to advert to this curious and useful operation, in various modes of its application; meanwhile I conclude this sketch with the following interesting and pious observations, suggested by the subject of grafting, which are contained in a late deservedly popular work:—'It cannot be unworthy of remark, that a phenomenon so striking as that of the mountain-ash, bearing, instead of its own little sour and unwholesome berries, large, sweet, and nutritious pears, in consequence of engrafting, has given rise to a scriptural metaphor, most expressive of a like change in our moral nature, one that is as true, in point of fact, as certainly accomplished by appointed means, and as beneficial in its effects, comparing the fruits of the old nature with those of the new. It becomes not immortal beings to admire the one mystery, and to overlook the other. It becomes not me to tell a fellow-creature the remarkable art by which his trees may be fruitful, without reminding him that he is himself a tree to be engrafted; and it becomes neither him nor me to study the fruits which we shall gather, without considering the fruits which we bear. May we, who are gardeners in the Lord's vineyard, be wise in the heavenly art, as well as in the earthly; that we may see around us the blossoms and fruit of the engrafted word, which is able to save the soul; and may we give ourselves earnestly to the work, lest the Lord of the vineyard cut down our trees, because, when he came and sought fruit thereon, he found none.'*

* Paterson's 'Manse Garden,' p. 111.

THIRD WEEK—FRIDAY.

HORTICULTURE.—THE GOOSEBERRY AND CURRANT.

THERE is no fruit of the British garden or orchard equal to the strawberry for fragrance of flavour, or to the gooseberry for utility or general acceptance. The gooseberry, and its congener, the currant, are indeed the vines of the north; and it is a new instance of paternal care, that this substitute should have been afforded to our climate, for the delicious grape of warmer regions. Viewed in this light, it is a curious fact, that these fruits, and especially the gooseberry, just begin to acquire their good qualities when the grape, in the open grounds, begins to degenerate. In the southern provinces of France, for example, where the vine is successfully cultivated, the gooseberry produces fruit scantily, and of no value; and in the north of that country, and more especially in the counties of England adjacent to it, where the vine is niggardly of its produce, the gooseberry grows luxuriantly, and acquires an agreeable taste, which increases as it extends northward.

The history of the gooseberry is little known. If it be not a native of Britain, it has, at all events, been long naturalized here, and it nowhere thrives better. In the reign of Henry VIII. it was familiarly known in this country as a garden plant, as appears by the following distich of Tusser, a writer on husbandry, who lived at that period:—

> 'The barberry, respis,* and gooseberry too,
> Look now to be planted, as other things do.'

This plant may be said to be the solitary fruit of the labourer's garden, in the northern parts of our island; and to him it affords a wholesome and grateful luxury. In Lancashire it is eagerly cultivated by the manufacturing population, and the people vie with each other in the successful production of this fruit. It is, however, more to the size than the

* Raspberry.

flavour of the gooseberry that their attention is directed, because this is the most palpable, though assuredly not the most agreeable quality, the taste usually becoming less rich as the size increases.

'The Gooseberry Shows of Lancashire, Cheshire, Staffordshire, Warwickshire, and other manufacturing counties, are conducted with great system; and an annual account of them, forming a little volume, is printed and published at Manchester. The heaviest gooseberry, which appears to have received a prize, was exhibited at the Shakspeare Tavern, Nantwich, in 1825; it weighed 31 dwt. 16 grains.* The prizes given on these occasions are adapted to the manners of the homely people who contend for them, being generally either a pair of sugar-tongs, a copper tea-kettle, (the favourite prize), a cream-jug, or a corner cupboard. The proceedings of these contests, and the arrangements for future years, are registered with as much precision as the records of horse-racing; and doubtless the triumphs which are thus handed down to the colliers' or the weavers' children, by the additions which the goodman makes to his household ornaments, are as deeply valued as the "gold cups of Newmarket."'†

The moral effect of the cultivation of the gooseberry in the manufacturing districts, is spoken of with approbation in the 'Library of Entertaining Knowledge,' and most certainly such an agreeable relaxation is unspeakably preferable to the degrading vices to which the population of these crowded parts of the country are addicted. If the healthful occupation of the garden withdraws the manufacturer from the corrupting habits contracted in the tavern, much is gained, at least

* The gooseberry plant, under favourable circumstances, will attain a considerable age, and grow to an immense size. At Duffield, near Derby, there was, in 1821, a bush, ascertained to have been planted at least forty-six years, the branches of which extended twelve yards in circumference. At the garden of the late Sir Joseph Banks, at Overtonhall, near Chesterfield, there were, at the same time, two remarkable gooseberry plants, trained against a wall measuring each upwards of fifty feet from one extremity to the other.—*Hort. Trans.* vol. v.

† Vegetable Substances, p. 269.

of a negative nature, in preserving his morals; and doubtless something positive also, in opening and enlarging his mind, and promoting his domestic enjoyments. The prize-shows, however, are of a more doubtful character. If they tend to foster vanity, and excite any thing of the spirit of the *turf*, all that can be said of them is, that they are at all events a hundred-fold less pernicious than those favourite but most demoralizing amusements of their superiors, to which they have been compared.

The effect of the competition above alluded to, on the gooseberry itself, is very conspicuous, but not entirely advantageous. It has, as I have already hinted, turned the attention of cultivators from the superior qualities of the fruit to its superior dimensions. In the fruit catalogue of the Horticultural Society of London, there are nearly 200 different kinds enumerated, of which no fewer than 150 are the Patagonian gooseberries of Lancashire.

The varieties of the gooseberry may be said to be almost endless, being propagated by seeds, the produce of which is not only affected by soil and climate, but is very various in itself, perpetually appearing in new kinds. The following, however, may be taken as a general description of the qualities, so far as they are associated with colour. The yellow are of a more rich and vinous flavour than the white,—the white than the green. The red are very various in flavour, but are commonly more acid than the others, though to this latter remark there are many exceptions. From this description, it follows that the yellow are most proper for the dessert, as well as for being fermented into wine, while the red make the most agreeable preserves.

The currant is perhaps also a native of this country, although it has been regarded as the degenerated grape of Corinth, from which circumstance it derives its name; and, indeed, there is a small seedless grape, in the Levant, which is known by the same appellation, and from which it is possible that it may be derived. In 'Dodoen's History of Plants,' translated in 1578, it is called 'the red beyond-sea gooseberry.'

There are three distinct varieties of the currant—the white, the red, and the black, differing from each other in flavour, as well as in colour, and each possessing some valuable characteristic qualities. The black currant, especially, has distinguishing peculiarities; its flavour is wilder than that of the other two, and it is supposed to be particularly salubrious, and even medicinal.

I have already adverted to the providential arrangement by which the gooseberry has been made to succeed the vine in our comparatively northern regions; and the same view has been so well expressed by an excellent writer, that I shall conclude this account in his words. 'Divine bounty is equalized to the nations. Italy has the grape; but there the gooseberry will not grow, or it will live only as an evergreen shrub, incapable of producing fruit; and it is further pleasant to observe, that, in the large field of the world, proper to the cultivation of our vine, its annual produce is less precarious than that of any other tree—a further proof that the things which are really best for man, are also the most abundant and the most easily produced. Were the pine-apple, which sells at one guinea per pound, as easy to be had as the potato or the gooseberry, no family would ever have done with the physician.'*

THIRD WEEK—SATURDAY.

HORTICULTURE.—THE ORCHARD.

THERE are fruit-bearing trees, as well as plants and shrubs, which man has appropriated to himself. Of these there are chiefly two kinds—those which have their seeds inclosed in an edible, fleshy, or succulent substance, and those which, along with a similar substance, have their seed also protected by a stone. Of the former kind are the apple and pear, of the atter the plum and cherry.

The history of fruits is not less curious and interesting than

* Paterson's 'Manse Garden,' p. 113.

that of vegetables; but I must hasten to other subjects, and shall compress, within a single paper, all that seems necessary, in this place, to say regarding them. Most of our European fruits appear to have had their native place in the East; and among these may be named the apple and the pear. Of both these fruits there are very numerous varieties, the Author of Nature having in this, as in other departments of the vegetable world, left much to the power of cultivation, in conformity to that beneficent law, so often adverted to, which calls forth industry and ingenuity, by rewarding their labours. Between the wild crab and some of our finest garden apples, the difference is immense; and the same may be said of the sloe and the plum; while this difference is chiefly to be attributed to cultivation, which selects and cherishes the most useful kinds.

The apple was common in Syria in the days of Solomon, who, in his Songs, as well as in the Proverbs, speaks of it with approbation; but it seems to have been rare in Rome, even so late as the days of Pliny. When, or under what circumstances the art of engrafting fruit-trees was introduced, is not known; but it must have been familiar in Judea in the age of the Apostles, as St. Paul draws one of his remarkable metaphors from this source.* I am not aware that it is any where mentioned at an earlier date; and it would appear to have been but partially known in Italy still later, as Pliny notices the art in terms of admiration, which seem to imply that it had been but recently practiced. To this art we owe the facility of propagating particular sorts, and these have lately multiplied to a remarkable degree. The varieties of apples at present known are upwards of a thousand, and of pears the fruit catalogue of the Horticultural Society names about six hundred kinds. From both of these fruits an agreeable fermented liquor is obtained.

Of stone fruits, the plum and the cherry are the only kinds extensively cultivated in this country; but the peach, the nectarine, and the apricot, are also reared on the walls of our

* Romans, 11th chapter.

gardens, although these delicious fruits are too delicate for open exposure as standards in this northern climate. Both the wild plum and the wild cherry are natives of Europe, though the finest kinds of each seem to have been brought from Asia, that original depository of almost all the most valuable vegetable stores of the world.

In tracing the history of fruits, it is remarkable to observe their connexion with the progress of civilization. As our taste refines, and our wants accumulate, the means of gratifying them are extended; and this is doubtless a wise provision of the Creator, by which the stimulus to exertion is kept up, and man finds himself in this, as in other respects, in the midst of a wide and constantly increasing field of enterprise, in which he never ceases to achieve new triumphs for his genius and talent. While the sense of taste is a singular and important gift, the means which have been provided for its gratification form a very pleasing department of study, in considering those adaptations, which subsist between the vegetable and animal worlds, and which afford an undeniable proof of Creative intelligence and goodness. It is by their organ of taste, combined with that of smell, that the lower animals distinguish and select their food. What precise kind of sensation this organ produces among them, or whether or not it be similar in different orders, it may be impossible to determine; but that, while it, in some respects, differs from the human sensation, it is decidedly of a pleasurable nature, there can be no boubt. To them, indeed, the pleasure of the palate forms the chief charm of existence; and it is beautiful to observe in how many ways the Creator has contrived to prolong the enjoyments derived from this source. Among these, the provision which is bestowed upon ruminating amimals of chewing the cud is not the least remarkable. They thus are enabled to enjoy the pleasure of eating a second time; and the latter pleasure is probably more delightful than the former. It is impossible to see a herd of cattle lying on a sunny meadow, amidst the luxuriant herbage they have been cropping, quietly and at their ease re-masticating their plentiful

meal, without being convinced that the spirit of enjoyment rests on them; furnishing a new evidence of that Divine benevolence which, notwithstanding the disorder of a fallen world, is so remarkable a feature in the character of the Author of Nature, as reflected from his works.

But a far more refined and varied pleasure, arising from the sense of taste, is enjoyed by man. The lower animals, indeed, show preferences in the choice of their food; and the greediness with which they devour one kind of vegetable production rather than another, proves that they are capable of degrees of enjoyment, according to the peculiar flavour of their food. But this exists only to a limited extent, and seems to be bestowed chiefly, if not exclusively, as an instinct distinguishing between what is more or less salubrious. In the human species it is different. It is not so much instinct as experience and habit which regulates the choice of his food; and among articles of subsistence equally wholesome, there are great diversities as to what is palatable or otherwise. The truth is, that his sense of taste, as I have already hinted, is obviously intended as a stimulus to his active powers, as well as a source of varied enjoyment; and to accomplish this double purpose, he is furnished with a palate delicately alive to the perception of differences in flavour and pungency. Adapted to this palate are the various vegetable productions with which he is surrounded, or with which he can furnish himself, so diversified in their qualities and modes of existence, as well as in their manner of affecting his taste, and in the degree of enjoyment which they afford. It is striking to run over the numerous productions even of our common gardens and orchards with these considerations in our view, and to think of the roots, the tubers, the bulbs, the broad juicy leaves, the farinaceous seeds, the fleshy and succulent fruits, with their almost interminable varieties of fragance and flavour, of sweetness and acidity, of mellowness and pungency, all so wonderfully suited to gratify the taste, and stimulate the appetite. If we look beyond our own country, and think of the vegetable produce of other climes, we find the

catalogue wonderfully increased, and discover still more reason to admire the diversified resources of nature, and the peculiar sensitiveness of the human palate, which can so accurately distinguish, and with so much relish appreciate, all that is exquisite in these diversities. The east, the west, the north, and the south, all furnish new and agreeable means for the gratification of his sense of taste; and in the varied sensations to which these varieties give rise, new departments are opened of commercial activity, discrimination, and enterprise.

That this extensive and curiously varied system of edible vegetation has been constructed for wise purposes we might, *à priori*, be entitled to conclude, from considering the wisdom which appears in every other department of nature. That its effects are practically useful, and admirably adapted to the circumstances and character of man, will be obvious if we consider what the effect would be of a different system. Let any man for a moment imagine to himself what consequences would arise from the human palate being formed with the obtuseness of that of the brutes. I do not speak of the sensual enjoyment which we would thus lose, for that, to a right constituted mind, is little. The Scottish cottager, in his frugal repast of potatoes or of prepared corn, may feel as much real content, and as substantial a pleasure, as the gourmand, surrounded with all the luxuries of the table. But I refer to the effect that would be produced on the human community. Those who are aware of the workings of society, will scarcely think it too much to say, that had not the nice perceptions of the human palate been bestowed, a vast stimulus to mental and bodily exertion would have been wanting,—which, to say the least, must have most materially interfered with the advancement of mankind in the race of civilization.

The recent transportation of fruits from one region to another, has been very happily employed by Hume to prove the comparatively late origin of the human race,—and may certainly serve, though he meant it not, as a collateral argument in favour of the Mosaic history of our globe.

'Lucullus was the first,' observes he, 'who brought cherry-trees from Asia into Europe; though that tree thrives so well in many European climates, that it grows in the woods without any culture. Is it possible that, throughout a whole eternity, no European had ever passed into Asia, and thought of transplanting so delicious a fruit into his own country? Or if the tree was once transplanted and propagated, how could it ever afterwards perish?' He makes a similar remark as to the vines of France, and the corn and animals which have been transplanted within these three centuries to America; and then he adds, 'all these seem convincing proofs of the youth, or rather infancy, of the world; as being founded on the operation of principles more constant and steady than those by which human society is governed and directed. Nothing less that a total convulsion of the elements will ever destroy all the European animals and vegetables which are now to be found in the Western world.'

This subject cannot be presented with the same precision as the geological inquiries of Cuvier; but, assuredly, the circumstances alluded to have a tendency to confirm his argument in favour of the fact, that the present surface of the earth is not of more ancient origin than the period assigned in the Inspired Volume to the deluge; and thus, the vegetable and animal productions of our globe speak the same language as the soil on which they grow, and raise their united voices to confute the sceptical arguments of the infidel.

FOURTH WEEK—SUNDAY.

SPIRITUAL SOIL.

Leaving out of consideration the influence of climate, the growth of vegetables depends partly on the quality of the seed, and partly also on the nature of the soil, and its state of

cultivation. The same thing may be said of the growth of spiritual life in our hearts; and our Saviour, in his beautiful parable of the Sower, has very strikingly described the different reception of Divine truth in the minds of hearers of different characters, by alluding to this analogy. The preacher of the Gospel is represented as a sower scattering the seed of God's word. It is precisely the same seed which is sown, possessing in itself the same living qualities; but the soil is various, both as regards natural fertility, and careful preparation.

Those who hear the message of salvation without any emotion, are compared to a wayside, hardened by the treading of many feet. First have moved, unresisted, over the heart, a host of evil inclinations, to indurate the soil; then, crowding in the same track, have passed a long train of wicked examples; and then comes habit, with its stiffening influence, to complete the evil, and to render the labour of the spiritual husbandman vain. The seed is sown, but it penetrates not that beaten soil. It lies uselessly on the surface, till 'the fowls of the air come and devour it up.' It is impossible to look abroad over the face of the Christian world, and not to be sensible that there are many who thus receive a preached Gospel. They join a congregation with hearts which the world has rendered callous and hard, and they listen to the truths of the Gospel without any desire to profit by them. To them the Sacred Volume unfolds its treasures of divine knowledge in vain. It speaks of human guilt, but it moves them not, although their own bosoms echo back the awful truth; it whispers mercy to the believing and trembling sinner, but them it moves not. It speaks of an offended Judge; it speaks also of a reconciled Father; but neither by hope nor by fear, by awe nor by affection, are they moved. They are told of the wonders of redeeming love, and the unspeakable grace of a crucified Saviour; yet they hear it all as an often-repeated and tiresome tale, in which they have no personal interest; and with closed eyes and shut ears, and consciences seared, they run recklessly to destruction. It is the god of

this world who catches away the seed as it falls; and thus the very means of grace, the very ordinances of the Gospel, become a snare to their souls.

These are the totally careless and indifferent; but there are others, whose situation is scarcely less hopeless, and yet they are religious professors. These are, in the parable, compared to the stony places, on which the seed falls from the hand of the sower. Here the young blade springs up suddenly, because there is no deepness of earth; 'but when the sun is up, it is scorched, and because it has no root it withereth away.' This forcibly describes those sentimental hearers, whose feelings, being susceptible, receive hasty and ardent, but fleeting impressions of religion. Their hearts overflow, and their eyes weep, when they think of their Saviour's sufferings. They tremble under the terrors of offended justice, and they exult in the hope of salvation, as the preacher sets before them alternately the threatenings and the promises of the Gospel. But there is no depth in their feelings; there is no solid foundation in their religious character. With the very same levity with which they were incited by the eloquence of the preacher, to weep and to rejoice, they are induced, under other circumstances, to neglect their religious duties, or even to abandon their religious principles. These 'have no root in themselves,' and hence they only 'dure for a while.'

It is a frequent and fatal mistake to separate religion from the duties of active life. The test by which we ought to examine the genuineness of our faith,—by which we should try the strength and stability of our religious principles, is the effect produced on our conduct in the intercourse of society. In the day of trial, have these principles sustained us? In our combats with an evil world, have they brought us off victorious? Amidst the seductions of passion, and the temptations of evil example, and the ridicule of the profane, have we stood firm as a rock, looking to Jesus, trusting in God, triumphing in the hope of immortality? These are questions by which we may discover how far we are removed from the

character of those whom the parable describes under the figure of stony ground, in which the seed springs up and dies,—whose religious feelings, having no depth, prove to be nothing more than a hasty, vain, and deceitful show.

But there is still a more common character among hearers in a Christian congregation,—those whom our Saviour compares to a soil overgrown with thorns, which, though cut down, and subjected to the operation of the plough and harrow, have not been rooted out, and therefore spring up along with the seed, and choke its growth. Those who possess this character, differ from the callous and indifferent in this, that they 'hear the word:' it makes some salutary impression on their mind: And they differ from the sentimentalists in this, that they are not betrayed by the ardour of a heated imagination. They have soberly studied the evidences of Revelation, and their judgment is convinced. They believe that the Bible is the word of God: they acknowledge its importance, and they are resolved, at some future 'more convenient season,' to devote themselves to the service of their Redeemer; but at present they are immersed in the cares of the world, and subjected to the influence arising from the real importunity of these cares, and their fancied magnitude. Perhaps they are in straightened circumstances, and they make sheer necessity their excuse for devoting themselves to worldly objects; or, if they are in affluence, wealth, as well as poverty, brings with it many employments and many cares; and not less easily does the worldly mind, in this instance, find plausible excuses for neglecting the calls of religion. The difficulty, however, does not, in either case, really lie in want of opportunity to devote themselves to the service of their Divine Master, but in want of inclination. They are 'cumbered about many things,' and forget that there is only one thing peremptorily and essentially needful. They take anxious thought only about 'what they shall eat and drink,' or how they may best obtain and enjoy the pleasures of life. But if they were to 'seek first the kingdom of God and his righteousness,' and then apply, as a subordinate object, to the

gaining of a provision for their families, Christ has himself declared, that this earthly blessing would be added to them; and unless they seek first the kingdom of God and his righteousness, all the leisure and opportunities which may be afforded them, will be unavailing. The 'good seed' will still fall among thorns, which will choke its growth, and render it unfruitful.

How thankless, how heartless, were the labours of the spiritual husbandman, if it were always thus,—if, after all, no fruit were to crown his toil! But, blessed be God, it is not so. Some seed also falls on good ground,—on ground, indeed, naturally overgrown with weeds, and therefore incapable of receiving it; but so prepared by previous culture, as to retain and nourish it, and, under the genial influences of Heaven, to bring the fruit to maturity. It is thus prepared by the hand of God himself,—no inferior hand could successfully prepare it.

And let it further be remarked, in following out the analogy of the parable, that whatever pains an agriculturist might take in cultivating his farm, it could never be made to produce a crop of itself. It would, after all, remain unproductive, without the genial influences of the seasons. The sun must smile upon it, and the clouds must interpose their grateful shade, to protect it from the sultry heat; and the dew of night must rest upon the tender blade, and the soft showers of heaven must bless the springing thereof. It is God who, with his own hand, 'covers our valleys with corn, and causes them to shout for joy.' Just so it is in the spiritual world. Not only must our hearts be prepared, and the seed of the word sown in a good soil, but Heaven must shed its blessed influences from above; and the Sun of Righteousness must shine upon it; and the warmth of heavenly love must cherish it; and the dew of Divine grace must distil upon it; and even the clouds of adversity must frown, and the raindrops of affliction must water it.

FOURTH WEEK—MONDAY.

PRODUCTIONS OF WARM CLIMATES USED FOR HUMAN FOOD.—THE BANANA.—THE DATE.

The productions of tropical regions are much more luxuriant than those of the temperate zone; and such as are employed for the support of human life, are both more numerous, and naturally more abundant. They require less of the arts of cultivation; and it is no slight or equivocal proof of wise adjustment, that, in a climate where the excessive heat precludes hard and incessant toil, the food of man should be almost spontaneously provided for him. The consequence, however, is, that the human family have their faculties less vigorously developed in this than in cooler climates.

Of roots, there are, among many others, the cassava, the arrow-root, the batata, the yam, and the aracacha. Of vegetables, rice, maize, millet, kidney-beans, and various kinds of pulse, may be particularized. Among trees, there are the orange with its varieties, the tamarind, the banana, the cocoa-nut, the bread-fruit, &c. Besides these, there are various productions from which, though not articles of food themselves, different kinds of substances used extensively at our tables are extracted, such as the sugar and tea plants, the cocoa or chocolate tree, the sago palm, &c. &c. The spices of these climates, too,—where, to use the language of our Scottish bard, 'Bright beaming summers exalt the perfume,'—are numerous and delightful; and all these varieties of vegetable productions, calculated to add to the enjoyments, and to promote the commercial spirit of the human race, tend to increase the gratitude of the pious heart to the Giver of all good.

Among such a variety, it is difficult to make a selection; and yet it seems desirable that the vegetable food peculiar to warm climates should receive some notice. Before describing any particular plant, there is one general observation which

must not be forgotten, as it is an instance of peculiar and wise adaptation. The vegetable food of tropical regions is constantly intermingled with productions remarkable for their pungency and their acid qualities, in which particulars it differs materially from the food of colder climates. Of this kind are the whole orange genus, the tamarind tree, and the pepper plant. The providential intention of this cannot be mistaken. Acids, having a cooling effect on the animal frame, are peculiarly grateful and refreshing under a burning sun; while the relaxed state of the stomach, when oppressed with excessive heat, requires stimulants, such as pepper and other plants of this nature supply. Adaptations of a similar kind of food to climate are known to prevail in all regions, and are probably more numerous than have yet been ascertained.

The banana is perhaps the most useful, universal, and characteristic fruit of the torrid zone, and it may therefore be taken as a proper representative of the esculent vegetable productions of these regions. It is remarkable that this plant, like the corn plants of temperate climates, whose place it supplies, is not known in an uncultivated state. The wildest tribes of South America, who depend upon this fruit for their subsistence, propagate the plant by suckers; and the necessity which Nature has thus imposed on them, has raised them to the rank of cultivators, and given them the first rude notions of industrious labour. Eight or nine months after the tree has been planted, it yields its fruit in great abundance; and when this is removed, and the stalk cut, it again yields fruit in three months. Its stalk is herbaceous, and shoots upwards to the height of fifteen or twenty feet, being about five or six inches in diameter at the surface of the ground, and tapering towards the top. The leaves, which are very large, are formed in a cluster at the top of the stem, and in the centre of these the spike of flowers rises to the height of about four feet. From the flowers the fruit forms rapidly; it turns yellow as it ripens, and is filled with a pulp of an agreeable

flavour and nourishing quality. It is exceedingly prolific. A spot of a little more than a thousand square yards will contain from thirty to forty banana plants. A cluster of bananas, produced on a single plant, often contains from 160 to 180 fruits, and weighs from seventy to eighty pounds. But reckoning the weight of the cluster only at forty pounds, such a plantation would produce more than 4000 pounds of nutritive matter. Humboldt compares this quantity with that yielded by wheat and potatoes, and calculates that the produce of the banana, in a given space, is to that of wheat as 133, and to that of potatoes as 4 to 1.

The nutritive matter of the banana, however, weight for weight, bears no comparison with that of wheat, or even of potatoes; but its superior quantity far more than compensates for this difference; and Humboldt maintains, that a piece of ground, planted with bananas, will support twenty-five individuals, when a patch of similar extent would support only a single individual, if sown with wheat.

This immense production of food, which seems to be intended to render the regions of the tropics peculiarly populous, has not yet effected this purpose to the extent which might have been expected. Both moral and physical causes seem to have combined in retarding such natural results. The enervating power of the climate, the debasing influence of tyrannical governments, the depressing effects of caste and of superstition, and the devastations of exterminating warfare, have all doubtless united, in no slight degree, with the sedative operation of a profusion of food obtained with little labour. The happy consequences to the human character of a colder climate, and a more scanty supply of food have elsewhere been pointed out;* and it was certainly in the temperate regions that the human powers and faculties were destined to be first powerfully called forth and cultivated. But we see operations in progress, which may eventually, and at no distant period, produce a great moral change in the condition of the inhab-

* See 'Spring,'—Origin of Agricultural Labour, &c., &c. pp. 234—238.

itants of tropical countries, and thus develope the intentions of Providence in supplying these regions so plentifully with the means of subsistence.

The wide and fertile plains of Eastern India are ripe for an experiment, which will probably have a powerful and lasting effect on the destinies of the world, and will unfold views of the intentions of Providence as to the abundance of tropical food, which have as yet failed to be practically realized. The intelligent inhabitants of Europe have indeed visited and conquered extensive regions between the tropics; but they have either been repressed in their energies by an ignorant, oppressive, and jealous government in the native country, or have only taken up a temporary residence in a region which they regarded as a species of banishment from their native home, while the curse of slavery attended their steps, and blasted their efforts at improvement, demoralizing their own characters, and embittering the days of those brutalized beings who were the objects of it.

A brighter prospect seems to lie before us.—While in the torrid regions of America the people have emancipated themselves from the yoke of the mother countries and are gradually shaking off the corruptions and degradation to which they were thus subjected, the Eastern regions, which Providence has placed under the milder and wiser sway of Britain, have been for a number of years preparing for a still higher destiny. The natives, naturally acute, are becoming enlightened by education, and by intercourse with their European masters: the prejudices of caste, and of a debasing faith, are disappearing; and industrious habits are increased and increasing. A monopoly, become useless and burdensome, has been abolished! Our enlighted and industrious island is about to pour its surplus population on these prolific lands. They will carry with them the activity, the wisdom, the agricultural and commercial spirit of their native country: and, above all, the light and enlargement of its holy religion. They will in that fertile region obey the great law of their nature, without any immediate or sudden check; and while they 'increase and

multiply and replenish the earth,' they will call forth and bring into practical exercise those exuberant powers of vegetation, which seem to be awaiting so auspicious an era. May we not, without being accused of Utopian extravagance, be permitted, under such conditions, to anticipate the time when even the prolific banana tree will not suffice to supply the increasing wants of a dense and flourishing population; and when the hills and valleys of this renovated region will smile under the blessings of varied and grateful fruits; of numerous vegetable productions of other kinds, for food, for commerce, and for manufactures; of herds and flocks; and of industrious men plying their labours in cultivated field and watered meadow. And, to crown the whole, may we not hope that idolatry and superstition will take alarm at the increasing light, and depart; that the huge temples of the horrid Juggernaut will give place to the churches of the living God; and that his bloody worship will be succeeded by the deep-breathed prayers, the tender affections, and the ennobling hopes and aspirations of the servants of the Prince of Peace. What Christian does not pray for so happy a consummation? What statesman would not think himself honoured in promoting it?

Another family, that of the palm tribes, is very peculiar and important among the trees of the tropical and adjoining regions, productions of this class being justly ranked among the most magnificent and elegant, as well as useful, of the vegetable world. There are numerous varieties, among which the sago-palm of Asia furnishes the greatest quantity of nutritious matter; and indeed, next to the banana, it is the most prolific in food of any other plant, a single tree sometimes furnishing, in its fifteenth year, not less than six hundred pounds of sago. It is not, however, my intention to prosecute, at present, the inviting subject of tropical fruits; and I shall confine my further notice of fruit-bearing trees, to the peculiar properties and habits of the date-palm.

This singular tree cannot properly be said to belong either to the tropical or the temperate regions, its natural locality being regulated by other circumstances than climate, while a

very considerable degree of heat is necessary for the development and ripening of its fruit. The date is, in the vegetable world, what the camel is in the animal; and, being a native of the same regions, it seems indeed intended as its companion and co-adjutor, in rendering fit for the habitation of man, a very peculiar portion of the globe, which would otherwise be forlorn and desolate. That region constitutes the extensive district which lies between the confines of the Persian Gulf and the Atlantic Ocean, stretching to the extent of nearly four thousand miles, and possessing, from some peculiarity of cosmical circumstances, which is not very clearly understood, the disadvantage of want of moisture in the atmosphere, which causes great aridity in the soil, and renders it unfruitful. The consequence of this state of things is the existence of the great Sahara, or desert of Africa, and the wide-spread wilds of Arabia. For what purposes Divine Wisdom has formed so extensive a region of desolation, or whether it may yet be reserved for the industry and ingenuity of man, to render it habitable by means of Artesian wells, and other resources of art, it may be difficult to conjecture; but what I have at present to remark is, that we have here compensations and contrivances to mitigate the evil and contract its extent, analogous to the character of the Divine dispensations, where other apparent defects occur. The chief of these are to be found in the peculiar properties of the camel and the date-tree,—the latter being intended to supply human beings in these otherwise barren regions, with substantial and agreeable nourishment, the former to furnish them with a most useful servant admirably adapted to the wants of the locality.

Of the camel I have elsewhere spoken,* when adverting to the adaptation of organized existences to the peculiarities of climate;—the date-tree serves equally to illustrate the same providential provision. Of the districts we are now considering, there are particular spots and lines of great fertility, especially along the shores, and on the banks and deltas of the rivers; of which latter description Egypt is a well-known in-

* 'Winter,' Third Week, Tuesday.

stance. Wherever there is humidity, indeed, from any cause, throughout the whole extent of this region, there Nature exhibits in great vigour her prolific powers;—but along the verge of the desert, and in the smaller oases which here and there relieve the dreariness of the wilderness, the date-palm is the only vegetable on which man can subsist. The more lowly plants on that soil are chiefly of a saline description, such as euphorbias, salsolas, and cactuses, which retain their own humidity in consequence of their smooth and close rhinds, without much aid from external moisture; but their juices are in general too acrid, or too much impregnated with soda, for being used as human food. Over these the date-palm raises its trunk, and spreads its leaves, and is the sole vegetable monarch of the thirsty land. 'It is so abundant, and so unmixed with any thing else that can be considered as a tree in the country between the State of Barbary and the Desert, that this region is designated as the land of dates; and upon the last plain as the Desert is approached, the only objects that break the dull outline of the landscape, are the date-palm and the tent of the Arab. The same tree accompanies the margin of the Desert in all its sinuosities; in Tripoli, in Barca, along the valley of the Nile, in the north of Arabia, and in the south-east of Turkey.'*

There is hardly any part of the date-tree which is not serviceable to man, either as a necessary or a luxury, resembling in this respect the cocoa-nut tree, described in a previous volume.† When the fruit is completely ripened, it will, by strong pressure, yield a delicious syrup, which serves for preserving this and other fruits. The stalks of the bunches, as well as the kernels, are softened by boiling, and in that condition are used for feeding cattle. The conical tuft, in the centre of the crown, called the cabbage, formed of the future leaves, in their undeveloped state, is an agreeable esculent, resembling the chestnut in flavour; the fibrous part of the tree, as well as the strings, or stalks, that bear the fruit,

* Vegetable Substances, p. 350.

† 'Spring'—paper on the Dissemination of Plants, p. 282, &c.

are made into ropes, baskets, mats, and various other articles of domestic use. The cordage of the ships that navigate the Red Sea, is manufactured from the inner fibrous bark of the trunk. The trunk itself is converted into supports for the huts and tents of the natives, while the pith or medullary substance is partly farinaceous, and may be used as food, resembling the sago extracted from another species of palm.

It is worthy of remark, that a variety of this tribe is found in a similar locality as to soil and climate, on the coast of Coromandel, in the peninsula of Hindostan. This is a great leafy bush, the trunk of which is not more than a foot and a-half or two feet high, entirely covered by the drooping leaves. The pulp of its fruit is sweet and mealy, and the farinaceous matter contained in the trunk is abundant, but on account of its bitterness not very palatable. It is, however, gladly resorted to in seasons of scarcity, and has often saved the inhabitants from all the horrors of famine.

How curious are the arrangements of Providence; and how improving to the mind to trace their endless varieties. There are many things, indeed, as we have frequently had occasion to observe, the reasons of which seem to be beyond the powers of human research; but even in these, or connected with them, the inquirer finds compensations and adjustments, which clearly indicate designing Intelligence; and, while they irresistibly impress us with the conviction that the hand of God is there also, fill us with an assured confidence that even in what appears to our limited view deformity or defect, there is a hidden wisdom which will be developed in the course of ages, or, at all events, will burst on our admiring view, when we no longer 'see as through a glass darkly.'

FOURTH WEEK—TUESDAY.

TREES USED FOR OTHER PURPOSES THAN FOOD.

We have seen what a vast variety of vegetable productions have been destined to be used as human food, adapted to all soils and climates, and capable of great increase and amelioration by culture. In this we have had occasion to recognize and adore the paternal care of an all-bountiful Creator. But it is not with a view to subsistence, and the gratification of taste alone, with the concomitant stimulus given to the exercise of the bodily powers and mental faculties, that a Father-God has bestowed the vegetable stores with which we are so profusely surrounded. These, indeed, are gifts of primary importance. But there are other provisions of no mean value, to which the productions of the vegetable kingdom have been made subservient. In the volume on Spring, I have adverted to various plants, used as articles of manufacture; but I have hitherto only incidentally taken notice of the uses, either in this or other respects, to which trees are applicable. These seem now to require some attention.

The first thing after food and clothing, to which man naturally looks, is a comfortable habitation, and for this he is mainly indebted to the trees of the forest. Even in his rudest state, it is among these that he seeks shelter, and as he gradually emerges to a higher grade, it is to the timber which they yield that he is indebted for his most useful materials, in constructing the lofty palace as well as the lowly cot. His implements of domestic life, and his instruments of husbandry, are from the earliest to the latest period of human improvement, essentially indebted to the admirably adapted material afforded by trees. For the machinery used in commerce and the arts, timber is equally essential; and, above all, it is to timber that we owe the power of transport across the waters of the mighty deep, by which the dispersion of human beings over the surface of the habitable globe has

been effected, and that intercourse has been kept up which has contributed so largely to the advancement of commerce, and the arts and comforts of civilized life.

It would be a curious subject of speculation to inquire what would be the character and condition of man, had it pleased Providence to withhold from him the advantages derived from trees, merely regarding them as affording the useful article of timber. Into this speculation, however, I shall not at present enter, further than to observe, that, as it is doubtless, by the possession of a material applicable to so many important, and indeed necessary, purposes, that man has been enabled to carry into effect almost all his plans of utility, of convenience, or of luxury, as far as they have depended on the use of physical instruments; so, without it, talent and genius would have been most materially stinted in their means of action, and therefore in their growth; and although the human race might still have existed, they would have remained circumscribed in their locality by the extent of the island or continent where they were first called into being, with views unenlarged, and faculties unemployed. They would, in short, have been wild and unenlightened savages, rising, in all probability, no higher in the scale of existence, than the depressed Greenlander, or miserably degraded native of Australia. We have here another instance, to show that man depends for the improvement of the powers bestowed on him by his Maker, on the adaptations of external nature to his mental capacities; while to these capacities, the necessary adaptations have been most strikingly made.

The varieties in the qualities of timber, by which it is made subservient to the diversified purposes of man's necessities or ingenuity, is another subject of grateful admiration. The strength and durability of the oak, so admirably calculated for ship-building; the straightness, the elasticity and lightness of the pine, united with the ease with which it yields to the moulding hand of the joiner, pointing it out as peculiarly useful in the construction of houses; and the remarkable combination of all these properties in the ash,

which renders it, in an especial sense, the husbandman's tree, —are specimens of this accommodation, which may suffice at present, as, in another volume, I shall have occasion to resume the subject.

But besides the uses of trees for timber, whether as these respect necessity, convenience, or ornament, there are many other valuable properties possessed by different species of this class of the vegetable world. I have already spoken of the fruits, and other substances which they yield for the food of man; and I might also have mentioned their qualities in this respect, as regards some of the lower animals, and especially several of the insect tribes, to whom the leaf, the flower, the seed, the bark, and even the wood and pith, furnish each their own peculiar nourishment, and different tribes of which are useful to man.* But the bounty of the Creator is not less conspicuous in having by the same means provided various other peculiar substances of essential use in the arts. Of this nature is the principle of tannin, residing in the bark of the oak, the larch, and very many other trees, so remarkable for its preservative qualities; the galls, extracted from an excrescence on the oak, produced by the puncture of an insect for the purpose of depositing its eggs; the tar and turpentine manufactured from the pine; the various kinds of dye produced by the quercitron, the Brazil wood, the hiccory, the walnut, and the birch; the wax of the Brazilian and Andes palms; the tallow of the croton and piney trees; the gums from the acacias of Arabia and Senegal; the odoriferous gum resins from several trees of the East; besides numerous medicinal extracts, which add to the materia medica of all civilized nations.

These varied uses of trees form each a new example of Creative beneficence; and were it not necessary to hasten to

* Of this latter kind is the *coccus ilicis*, gathered in Spain from a species of dwarf oak, called Kermes, producing a beautiful scarlet dye; the silkworm, which receives its nourishment from the leaves of the mulberry; and the worm which the native Australians find in the pith of a tree of that country, and which they eagerly devour.

other matters, it might be advisable, as it certainly would be interesting, to enter with some minuteness into the nature of the provisions by which such productions are elaborated. The subject, however, is far too extensive to make this compatible with our plan; and I must be satisfied with a distinct notice of only a few kinds of produce of the most general utility and importance. These will occupy some succeeding papers; and, meanwhile, I must call upon my readers to remark once more the astonishing exuberance of Divine bounty in the diversified properties of the substances produced in the vegetable world, for human uses in the arts of life. I have already noticed a similar variety in the articles of food; and it cannot be doubted that the intention, in both instances, is the same; namely, to call forth, and afford a salutary excitement to the mental faculties, as well as to keep the bodily powers in healthy exercise. In both instances, too, the climate and localities so far separated from each other, and spreading indeed over the whole extent of the globe, through which these varieties are scattered, are additional examples of wise contrivance, by which social and commercial intercourse is promoted, and the whole human family are united by mutual ties of interest, which have already produced many happy effects, and seem destined rapidly to produce still more. The present aspect of the civilized world is, indeed, in this respect, peculiarly encouraging, and seems to hold out the most delightful anticipations to the Christian philanthropist.

FOURTH WEEK—WEDNESDAY.

VEGETABLE SUBSTANCES USED IN TANNING.

The art of tanning the skins of animals is of very remote antiquity. Pliny attributes the invention of leather to Tychius of Bœotia. But though so ancient, this art has only of late been brought under the consideration of scientific men,

having been merely pursued by practical persons technically acquainted with its various processes.

In England, the bark of our native oak originally furnished the only substance for the tan-pit; and this material, after it had served its purpose, was then thrown out as useless. It is said that William the Third first turned the attention of English gardeners to its value for horticultural purposes having imported the practice from Holland. Its useful qualities, however, in producing artificial warmth in hot-houses, though now generally recognized and employed, were little understood in this country for many years after the period of the glorious Revolution.

About a century ago, no practical man in this country suspected that the tanning principle resided any where except in the bark of the oak; and nothing was known of the principle itself, except that it possessed the power of preparing leather for use, and preserving it from decay. The growing scarcity of the material about this period, led to an inquiry into the subject, and it was discovered, that, so far from this useful quality peculiarly belonging to the oak, it was common to many other plants, and that in other places, people availed themselves of this knowledge. Heath pulverized, gall-nuts, and the bark of the birch-tree, were found to be used in Germany; myrtle-leaves, in some parts of Italy; laurel leaves in Corsica; the bark of the willow, in Russia; tormentil-root, in St Kilda; the bark of the red-mangrove-tree, in the West Indies.

M. Seguin, an excellent practical chemist, turned his particular attention to the principle of tanning, and published his experiments and discoveries in 1756, which threw on the subject the light of science. He found that there was a quality inherent in many vegetables, to which he gave the name of *tannin*, and on which the preservative powers of the process of tanning depend. The extract which he called by this name, is a brittle substance, of a brown colour; it breaks with vitreous fracture; does not attract moisture from the air; and is extremely astringent to the taste.

The hides of animals, when divested of the hair and epidermis, consist wholly of gelatin, a substance soluble in water, and forming, when combined with it, the well known jelly called glue. Tannin is likewise very readily dissolved in water; but, by a chemical change, the analogy of which is by no means uncommon, a union of the two forms an insoluble imputrescent compound; and hence the efficacy of tannin in the preparation of leather

The attention of scientific men being led, by these discoveries, to this curious and interesting subject, it was speedily found that tannin abounds in the vegetable kingdom. Sir Humphrey Davy, after a careful investigation of the subject, was led to the conclusion, that, in all substances possessed of the astringent taste, thereis reason to suspect the presence of tannin; and that it even exists in substances which contain sugar and vegetable acids. 'I have,' he adds, 'found it in abundance in the juice of sloes; and my friend, Mr. Poole of Stowey, has detected it in port wine.'

Various experiments have been made with the view of ascertaining the relative quantity of tannin in different vegetable substances. It is intimately connected with the mysterious process of vegetable secretion; and Mr. Biggin found that similar barks, when taken from trees at different seasons, differ greatly as to the quantity of tannin which they contain. More than four and a-half times greater quantity of tannin was obtained from oak-bark, cut in spring, than from an equal quantity of the same kind of bark cut in winter.* Sir H. Davy observed, that the proportion of the astringent principle in bark varies considerably, according as the age and size of the trees are different. These proportions are, besides, often influenced by accidental circumstances, so that it is extremely difficult to ascertain their distinct relation to each other.

There is another vegetable matter, called by chemists *extractive*, which is absorbed by skins, together with tannin,

* Philosophical Transactions for 1803.

and which gives them softness and durability ; and it is therefore necessary to take this property into account in the process. The leather produced by means of an infusion of galls, for example, is generally found to be harder, and more liable to crack, than that prepared by an infusion of barks, from the circumstance of a less proportionate quantity of extractive matter having entered into chemical combination with the skin. It is therefore a circumstance worthy of remark, as forming another instance of those wise adaptations which we have so continually occasion to remark in all the operations of nature, that extractive is constantly united with tannin, in those vegetable substances used in the preparation of leather, and situated in such close contact* with it, that, in all ordinary operations, they will always be used together, except intentionally separated. They are substances of very different chemical properties, as well as applied to uses altogether different in the vegetable economy ; yet they are both of great importance in the operation of converting hides into leather ; and the adaptation consists in this, that they *both* exist in the bark ; by which arrangement they have, from time immemorial, been used together, without the tanner being at all aware of it. It was only late chemical analysis, indeed, which caused them to be distinguished.

In considering this subject, therefore, with reference to a Final Cause, were we even to grant, which I am very far from doing, that the use of bark in tanning hides, is the mere result of human experience, unintended by the Creator, there still remains the remarkable circumstance I have mentioned, of the conjunction of two unallied chemical properties in the bark, both of them of essential importance to the perfection

* 'In every astringent bark,' says Sir H. Davy, 'the interior white bark, that is, the part next to the albumen, contains the largest quantity of tannin. The proportion of extractive is generally greatest in the middle or coloured part; the epidermis seldom furnishes either tannin or extractive matter. The white cortical layers are generally most abundant in young trees, and hence their bark contains, in the same weight, a larger proportion of tannin than the barks of old trees.'—*Phil. Trans.* for 1803.

of the process, with which human reason had assuredly nothing to do.

FOURTH WEEK--THURSDAY.

VEGETABLE FIXED OILS.

Vegetable oils are distinguished into two kinds, fixed or fat oils, from which no vapour is given off at the temperature of boiling water, and volatile or essential oils, which give off vapour at or below that temperature with water, or under 320° by themselves.

Those of the first class are obtained by expression, principally, if not entirely, from the fruit or seed of plants. A great variety of seeds are more or less oleaginous, more especially those of the nut kind, from all of which oil may be extracted. Many of the oils of this description are applicable to the arts, or are employed in combustion for producing light.

The vegetable oil most known and esteemed, is that expressed from the olive. This tree, which now appears as a native of Italy, luxuriating in a genial soil and climate, is not, however, indigenous to that country. Pliny, who largely discourses on the olive tree, and its produce, notices its first introduction; whence Gibbon remarks, 'The olive, in the western world, followed the progress of peace, of which it was considered as a symbol. Two centuries after the foundation of Rome, both Italy and Africa were strangers to that useful plant. It was naturalized in those countries, and at length carried into the heart of Spain and Gaul. The timid error of the ancients, that it required a certain degree of heat, and could only flourish in the neighbourhood of the sea, were insensibly exploded by industry and experience.'*

The olive and the cornel are the only trees in which oil is expressed from the pulpy part of the fruit, and not from the seeds or nut alone. The oil obtained from the kernel of the

* Decline and Fall of the Roman Empire, chap. ii.

olive, is believed to become rancid sooner than that obtained from any other part; and, therefore, in producing the best oil, care is taken that the stones are not cracked in the preliminary process of bruising the fruit; nor are they subjected to such pressure as would produce this effect at first, when the best oil comes over. The press used for this purpose is of a very simple construction. The fruit having been bruised by the action of a millstone, is transferred to the trough of a screw-press; and, after as much oil is obtained as can be extracted by the degree of pressure given, hot water is poured on what remains in the trough. The whole is then subjected to a stronger pressure, and a coarser product is procured. When all the oil is entirely expressed, the refuse is used as fuel.

The best soap is made of olive oil, mixed with alkalis; but its preparation for this purpose is not so carefully conducted as when it is intended to form an ingredient of food. Spanish soap, known in England as Castile soap, is made with olive-oil, which is also largely used for the same purpose at Marseilles. The heavy duty charged on importing olive-oil into this country, viz. eight guineas per ton, effectually prevents its application to soap-making in England.

This oil becomes solid at 10° of Fahrenheit. Its specific gravity is 913. It is never used in the composition of paints, as it does not dry completely. The olive-tree produces oil abundantly; and a plantation of this in a favourable climate, is always a certain source of profit to the industrious. 'The young olive plant,' says Maria Graham, 'bears at two years old, and in six years begins to repay the expense of cultivation, even if the ground is not otherwise cropped. After that period, in good years, the produce is the surest source of wealth to the farmer; and the tree rivals the oak in longevity; so that the common proverb here is, "If you want to leave a lasting inheritance to your children's children, plant an olive." There is an old olive-tree near Gericomio, which last year yielded 240 quarts of oil. Yet its trunk is quite hollow, and its empty shell seems to have barely enough of hold on the

ground to secure it against the mountain storm.'* More than 4,000,000 gallons of olive-oil were imported into Britain in the year 1831, very nearly one half of which was retained for home consumption.

Some parts of the south of Italy may be said to be one continued olive-grove. This description particularly applies to what may be called the heel of the boot, which forms an extreme point of the Neapolitan dominions. 'In a good year, and at a proper season,' says a writer quoted in the Library of Entertaining Knowledge, 'I have counted, in the course of an afternoon's ride, as many as a hundred mules returning from Galipoli, where they had been to deposit their unctuous burdens to different towns and villages in the Terra d'Otranto, or the more distant province of Bari. The quantity of oil required may be conceived when I state, that at one time (in the year 1816) I saw nine English, three American, two French, and six Genoese vessels (not to mention some small craft from the Adriatic), all waiting in the port of Galipoli for entire or partial cargoes of it.'†

It would be almost endless to state all the seeds from which useful oil may be extracted. Linseed oil, the produce of flax, is of general use in painting, and in the composition of varnishes. Its chief defect is the darkness of its colour. Hempseed also affords a very useful oil, similar in its qualities to linseed, but strongly impregnated with the peculiar odour of the plant. Next to these I may mention the *sesamum*, or oil-plant of the East, which is indigenous in the island of Ceylon and the Malabar coast. It is an annual, growing about two feet high, and producing seeds of the size of those of mustard. It is grown universally throughout Asia and in some parts of Africa, where the seed is valued, not merely for its oil, but as an article of food. The oil is abundant, nine pounds of seed yielding two quarts of this substance. It is perfectly sweet, and is used for the purposes of olive oil, while it has

* 'Three Months passed in the Mountains East of Rome in 1819, by Maria Graham.'

† Library of Entertaining Knowledge, Vegetable Substances, p. 20.

the great advantage of not becoming rancid, though kept for years. From the kernels of walnuts, hazel-nuts, and beech-mast, and from the seeds of the poppy, oils are extracted, which are much esteemed by varnishers, on account of their transparency. The latter is also extensively used in place of olive oil. The cocoa-nut, and some species of palm, likewise yield an abundant and useful oil well known in this country; the latter being chiefly used in the manufacture of a certain kind of soap, and the former being in very general use. The chief defect of the oil extracted from the cocoa-nut, was its congealing at the ordinary temperature of the atmosphere in England. Recently, however, a discovery has been made of a method of separating the concrete matter from the liquid part of the oil, by which means a pale, limpid, tasteless fluid is produced, possessing the property of combustibility in an equal degree with the best sperm-oil, while the solid unctuous substance is applicable to the manufacture of candles, and to other uses in which fatty matter is employed. This discovery will probably be of considerable importance to the inhabitants of Ceylon, where the cocoa-nut tree is cultivated in such abundance. The utility of its oil adds to the valuable properties of this wonderful tree, which, in a former volume, were shortly described.*

FOURTH WEEK—FRIDAY.

VEGETABLE OILS—ESSENTIAL AND EMPYREUMATIC.

WHILE the grosser oils are extracted from the fruit and seed, essential oils are for the most part obtained from the leaves and flowers, or from the most odorous part of the plants. In umbelliferous plants, however, the oil is found in the seeds. In the *geum* or *avens*, the root affords it; and in labiated plants, it is contained in the branches and leaves. The essential oils obtained from flowers are generally of a very delicate

* 'Spring,' p. 282.

nature; and the odorous matter of some flowers is so subtle, that it can only be obtained by impregnating other substances with it. Of this description of flowers are the tuberose, jassmine, honeysuckle, sweet-briar, and others having strong scents, but yielding little or no oil by distillation. Ben-oil, extracted from the seeds of a tree growing in the Indies, Ceylon and Egypt, which is perfectly inodorous, and not liable to rancidity, is an excellent agent for retaining and imparting the perfume of the sweet-smelling flowers.

Other essential oils may be obtained by distillation, water being added to the ingredients in sufficient quantity. In this manner, they are drawn from the various parts of plants which yield this substance, whether flowers, leaves, barks, roots, or woods, or from their extracts, in the form of gums or balsams.

The use of these oils to the perfumer is too well known to require explanation. Some of them are also employed in pharmacy and chemistry, others in confectionary.

But there are oils which partake of the nature of those named essential, which are of greater utility, and more extensive application. These are called empyreumatic oils, and are obtained by dry distillation.

Birch-oil is classed among these; it is prepared by the Tartars from the white bark of the birch-tree; and, what is singular, that which is extracted from bark in a rotten state, is esteemed the most valuable. It is used in the preparation of leather, for which purpose it is in great request, on account of its antiseptic qualities.

But a far more important extract, of an empyreumatic nature, is the tar, so extensively used for naval purposes. It is distilled from the wood of the fir-tree, and produced in large quantities in the north of Europe, and in North America. In the selection of the wood for this purpose, some care is taken, as particular trees yield much more tar than others. When a sufficient quantity is collected, a circle is marked out on the ground for the kiln. The earth is then dug out, a spade deep, sloping from the centre to the circumference, and

is thrown up, forming a bank round the circle. A straight pine, of sufficient length to reach from the centre some way beyond the bank, is split longitudinally, and hollowed out. The parts are then put together again, and one end is placed in the centre, being so supported on the ground, that this end is higher than that which comes without the bank, where a hole is dug in the ground, into which the tar flows from the channel, and whence it is from time to time taken out and barrelled for market, without any further preparation.

In packing the billets of wood in the kiln, the inward ends are made to slope towards the middle, which is filled up with smaller pieces consisting of knots of wood, the most oroductive part of the tree. After the whole billets are piled about twelve or fourteen feet high, a number of small logs are placed round it, than a layer of turf, and so on alternately throughout the whole height. The top is then covered over with two or three layers of turf. The fire is at length let in at the top, by removing the turf in ten or twelve different places; and the pile burns slowly downwards till the whole of the tar is distilled from it. Six or eight days are generally required to complete the burning of a tar-kiln of the dimensions here described.

The above is the common method pursued in the north of Europe; but though unexpensive, it is attended with great counterbalancing inconveniences. Among these the chief are, that the management of the fire is extremely difficult, and considerable loss takes place in extracting the tar. Other methods are, therefore, resorted to by persons possessing capital, which I must not stop to detail.

The quantity of tar retained for home consumption in 1830 was 5205 lasts.

Pitch, which is condensed tar, is obtained either by evaporation or burning. The process of burning is performed very simply. A hole is dug in the ground, and lined with brick. It is then filled with tar, which is ignited, and allowed to burn till the pitch is found to be of sufficient consistency, which is ascertained by dipping a stick in it, and allowing the pitch

adhering to it to cool. When the tar is sufficiently burnt, the hole is covered up, and the fire is thus extinguished.

When tar is converted into pitch in this country, a much more economical plan is pursued in the large establishments. Here no part of the tar which has any useful property is wasted. It is evaporated in a still, and consequently the valuable volatile products are condensed and preserved. The oil, the acid, and the water, which distil over, do not mix, and may be easily separated by further distillation. The oil is an inferior oil of turpentine, which is useful in coarse painting; the acid is strong and empyreumatic, very closely resembling the pyroligneous acid obtained from the distillation of wood. By this method 600 gallons, or 20 barrels of tar, will produce 10 barrels, or 2200 weight of pitch, 176 gallons of oil, and about 40 gallons of acid.

Besides the British made pitch, 5482 cwt. of foreign pitch were retained in 1830 for home consumption.

FOURTH WEEK—SATURDAY.

TREES.—TALLOW AND WAX.

THERE is yet another class of substances derived from some kinds of trees, which I shall describe on account of their singularity as vegetable products, and the uses which may be made of them both for domestic purposes and in the arts; I allude to such as bear a close resemblance to tallow and wax, both of which are but little practically known in our temperate climates, except as the produce of animal secretion.*

* Bees-wax was long believed to be collected by these industrious insects from flowers; but it is now satisfactorily ascertained that they secrete it through the rings of their body. Wax, however, is not altogether unknown, even in this climate, as a vegetable production. The experiments of Proust led him to believe that the bloom which silvers the surface of plums, and other stone fruits, is wax, and that the property of resisting moisture, which resides in the leaves of the cabbage and some other plants, is owing to the presence of the same substance. Some trees, too, such as the poplar and

A substance very nearly similar to tallow is procured from a tree growing abundantly in China, called the tallow-tree, or *croton sebiferum*, which is used by the inhabitants in making candles.

Mr. Clark Abel describes it as being one of the largest, the most beautiful, and the most widely diffused of the plants found by him in China. 'We often saw it,' he says, 'imitating the oak in the height of its stem, and the spread of its branches. Its foliage has the green and lustre of the laurel. Its small flowers, of a yellow colour, are borne at the end of its terminal branches. Clusters of dark-coloured seed-vessels succeed them in autumn, and when matured, burst asunder, and disclose seeds of a delicate whiteness.'*

The seed-vessels are hard brownish husks, not unlike those of chestnuts; and each of them contains three round delicately white kernels, resembling in size and shape our ordinary hazel-nuts, but having small stones in the interior. It is the hard white oleaginous substance surrounding these stones which is used as tallow, and possesses most of its properties, though its consistency is so great, that in stripping it off it does not soil the fingers. From the shell and stone oil is extracted, so that the fruit produces tallow for candles, and oil for lamps.

The tallow thus procured is not so cohesive as that produced from the fat of animals, and to remedy this defect, the candles are dipped in wax. Father d'Incarville, in a letter published in the Philosophical Transactions in 1753, states, that almost all the candles sold in the southern provinces of China, are made with tallow prepared from these berries. There are few sheep in that part of the country, which causes animal tallow to be very scarce, and enhances the value of this vegetable production.

The piney-tree, or *Vateria Indica*, growing on the coast of

alder, afford a decoction resembling wax or tallow. As for the latter substance, it is nearly akin to the oils which are not uncommon in the vegetable productions of temperate climates.

* Travels in China, p. 177.

Malabar, yields a substance of the same kind as that already mentioned. The peculiar product of this tree is described in an interesting paper, by Dr. Benjamin Babington, published in the 'Quarterly Journal of Science.' He has shown, from many experiments, that its inflammable properties admirably adapt it for the manufacture of candles, and, indeed, that it is in every way superior to animal tallow. This useful substance is obtained from the pulpy fruit, by simply boiling it in water, when it rises to the surface, and, on cooling, forms a solid cake.

The natives do not make use of the substance for light, candles being unknown among them, as the country furnishes many fluid vegetable oils, with which they feed the wick of their lamps; but they employ it medicinally, considering it an excellent application for bruises or rheumatic pains.

A resin, very similar in its properties to that of copal, exudes from the piney-tree, and furnishes a very durable natural varnish. This resin, when mixed up with the tallow of the tree, is used as a substitute for tar, in smearing the bottoms of boats.

The produce of the piney-tree might form a useful and profitable article of commerce. It grows abundantly along the western coast of the Peninsula of India, as far northward as the extreme limit of the province of Canara.

Wax is produced from a species of palm, which grows in the Brazils, and rises to the height of thirty feet, called by the inhabitants Carnauba. The lowlands on the banks of some of the rivers are covered with these trees. The leaves are two feet in length, and, while young, are folded in the manner of a fan: when they afterwards expand, they are nearly two feet in breadth. When cut from the tree, as soon as they have reached their full growth, and placed to dry in a shade, a considerable quantity of small light-coloured scales will be loosened from the surface. These acquire the appearance of wax, when fused, which takes place on the application of heat at 206° Fahrenheit. This wax is of a pale straw colour, and, when cold, is hard and brittle. Fixed oils, at the temperature

of boiling water, cause its solution. It possesses most of the properties of bees' wax, and, when made into candles, burns well with a steady light.

In the Philosophical Transactions for 1811, there is a detailed account of the experiments made on this wax, to ascertain its properties as an inflammable substance. These experiments proved highly satisfactory. It was found, that, when made into candles, with wicks of proper thickness, its combustion was in no respect inferior to that of bees' wax.

Nor is this the only useful product of the carnauba-tree. The green fruit, and the pith of the young stem, when properly prepared, afford nutritive food; the kernel of the fruit, when ripe, is covered with a layer of sweet pulp, which is found to be a wholesome nourishment for cattle; the beans make a very durable thatch for houses; and the trunk is serviceable as timber.

Another species of the highly useful and much diversified palm tribe, the *Ceroxylon*, produces also a substance possessing the properties of wax. It is a native of the Andes, and grows in high situations bordering on the region of perpetual snow. Humboldt describes the tree as attaining to the prodigious height of 160 feet, while it differs from all other species of palms, in flourishing under a much colder temperature. It might probably be cultivated with advantage in Britain, and would form a useful and beautiful variety in our plantations. It is on the trunk of this tree that the inflammable substance is found, of which I speak. Vauquélin subjected this product to chemical analysis, and found that it contained two-thirds of resin, and one-third of wax.

There are, in the northern quarter of the New World, shrubs which produce wax of a much purer quality. Of this kind is the myrtle of Louisiana, scientifically called *Cerefera angustifolia*, and another species, with broad leaves, which grows in Pennsylvania, Connecticut, and Virginia. These yield their wax from the berries, this substance surrounding a small stone in the centre of the fruit. When made into candles, this wax produces a clear white flame

affording a grateful light, while it emits an agreeable and healthful fragrance.*

It has already been remarked, that there are in various de-

* I cannot omit noticing among other productions of trees in warm climates, those which are to be found in Africa, that much injured country, to which benevolence is now turning its anxious regard. There are to be found in abundance not only the most valuable kinds of timber for the uses of the joiner, the cabinet-maker, and the ship carpenter, but the most varied substances produced by this species of vegetation applicable to the arts. Sir Thomas Fowell Buxton, in his late admirable work on the 'Slave Trade, and its Remedy,' after stating the different kinds of useful wood to be found in the African forests, says, 'Of dye woods there are also abundance, yielding carmine, crimson, red, brown, brilliant yellow, and the various shades from yellow to orange, and a fine blue. Of gums there are copal, Senegal mastic, and Sudan or Turkey gum, to be obtained in large quantities; and there are forests near the Gambia where hitherto the gum has never been picked. Of nuts, which are beginning to form a new and important article of trade, there are the palm-nut, the shea-nut, the cola-nut, the ground-nut, the nitta-nut, the castor-nut, and the cocoa-nut. The palm tree grows most luxuriantly, and incalculable quantities of its produce are allowed to rot on the ground for want of gathering; yet it is now the most important branch of our commerce with Africa, and may be increased to any extent. The oil expressed from its nut is used in the manufacture of soap and candles, and in lubricating machinery. The shea, or butter-nut, is scarcely less valuable than the palm-nut. Some travellers inform their readers that it is an excellent substitute for butter, and can be appropriated to the same uses with the palm-oil. It is a remarkable fact, in the natural history of these trees, that immediately where the one ceases to yield its fruit, the other flourishes abundantly.'—Pp. 321, 322.

I extract the above merely as a slight specimen of the spontaneous productions of Africa, from which the impolitic as well as inhuman slave-trade has almost shut us out. Thanks to the enlightened and indefatigable exertions of Sir F. Buxton, and his benevolent coadjutors, a strenuous, and I do trust, a successful effort, is now making for the civilization of Africa, founded on the prolific nature of its soil. He has demonstrated how incalculably superior, in point of mere mercantile profit, it would be for the African chiefs to employ the labour of their people at home in raising articles of commerce, compared with what is obtained from the iniquitous sale of their persons, or from slave hunting; and has, at the same time, proved by numerous facts, that the natives are not only capable of understanding their own interests in this respect, but, in many instances, eager to adopt a better system.—*Edition* 1841.

partments of nature, principles and qualities which seem to be lying waste, or which are, at all events, but partially employed, and which it only requires the judicious labour of man to call forth in abundance. In noticing this fact, I took occasion to state, that these resources lead us to look forward to a period in which the improvements introduced by genius and industry, will people the earth to a far greater extent than has yet been realized. A similar view may be taken of the vegetable powers which we have just been considering. The productions in question exist in a much greater profusion, than the wants of man in his present condition require; but the time may come when all their qualities shall be called into action, and shall contribute to the prosperity and comfort of a vastly increased population. The croton and piney trees may yet be eagerly sought after and extensively cultivated, for the sake of their tallow, and other properties; and the wax-palm of the lofty Andes, carefully reared in its own locality, or transplanted to our northern climes, may yet furnish its peculiar produce, to add to the resources of the arts, at a period when the dense population of an enlightened and industrious community, shall have found that the present means by which its use is superseded, have become too scanty for the supply of their incalculably augmented demands. The philosopher, as well as the man of piety, must therefore come to the conclusion, that, to allege that any natural production, capable of being turned to use, is superfluous or superabundant, merely because it remains at present unemployed, is quite premature and unwarrantable. He will even go further, and will see in the provision, a prospective contrivance of Creative Wisdom anticipating coming necessities, which opens to his mind the most magnificent prospects.

FIFTH WEEK—SUNDAY.

SPIRITUAL CULTURE.

The apostle Paul says of Christians, that they are 'God' husbandry,' which implies that they are under a process of cultivation. The metaphor is very striking and appropriate. The face of an uncultivated country is generally a wilderness, covered with weeds, brambles, and thorns, or encumbered with useless trees. Such is the curse of a fallen world. Before it can be rendered an agreeable and productive residence for human beings, the soil must be cleared of its natural produce; it must be divided into fields, and fenced in from encroachment; it must be turned over and pulverized; it must be ameliorated by manure, and good seed must be sown; or it must be adorned with useful plants and trees.

So it is with the human heart. The curse of the fall is on our souls, as well as on the ground. The natural produce of this living soil is weeds, and thorns, and noxious plants. These grow luxuriantly, and choke the good seed that may chance to be scattered on this pre-occupied wilderness. There is a difference, indeed, as has been said, in the natural quality of the soil. In one place there is the hardness of rock; in another there is the stiffness of clay; in another there is a native fertility. But while, in barren regions, nothing is produced but a sour and stunted vegetation, even the very richness of the soil causes poisonous herbs, and useless or baneful plants, to grow the ranker.

Such is the natural state of the human soil, and before it can become productive of good fruit, it must, like the soil of the earth, be subjected to the ameliorating influences of cultivation. It must be cleared of its unprofitable and poisonous produce; it must be skilfully dressed and prepared; it must be sown with useful seed; it must be watched over and preserved from depredation.

But let us drop this figurative language for a little, and

take a literal view of the human character. Such is the nature of our fallen hearts, that evil is more congenial to them than good. The moral principle within us is depraved, so that we are constantly inclined to harbour bad passions, and cherish worldly inclinations. In our infancy, we are selfish and trifling; as we grow up we become vain, malicious, and grasping; evil habits are formed, and intwine themselves round the heart. Our fellows are of like passions, and affections with ourselves. By mutual intercourse we corrupt each other, and so the work of demoralization proceeds. This is a hopeless state, if human means alone are employed. Men make progress in the arts and sciences, but they do not of themselves make salutary progress in moral culture. On the contrary, if we examine history, we shall find that society has almost uniformly made a retrograde movement in virtue and religion, as they advanced in civilization. Look at the antediluvian world. It was the improvement of men in the arts of civilized life, and their consequent familiar intercourse with the most depraved, but the most ingenious of their species, which caused that universal dissolution of moral and religious principle, that, in the days of Noah, was so signally visited with the vengeance of Heaven. Look at Egypt—at Babylon—at classic Greece and Rome,—and the very same effect will be observed. Consider the history even of the Israelites. They were not able, with all their peculiar advantages, to resist the corrupting influences of prosperity. Shall we draw a different conclusion from the history of modern Europe? It will not be said.—Its inhabitants, indeed, have possessed that which, if properly applied, would have preserved them from the contamination; but religion itself was corrupted, and thus the genial stream which might have produced salubrity, was vitiated at its source.

The soil of the human heart, then, considered with reference to religion, is naturally a wilderness, which grows only the more encumbered with a noxious vegetation, the more its fertility is increased. It may, however, be cultivated; but this, as formerly observed, can only be done by a Divine hand.

As well might you expect that the earth should change its nature and its produce without the culture of man, as that the moral soil should produce good fruit without the 'husbandry' of Heaven. Human means, indeed, must be employed. Such is the wise arrangement of the Supreme Governor; but without Divine aid, these means are altogether unavailing. Neither your own efforts, nor those of your spiritual husbandmen, can cause the sacred seed to take root and grow in your hearts. If the influences of Heaven be denied, these are all in vain. 'Paul may plant, and Apollos may water, but it is God who giveth the increase.'

This is, the important truth. The whole operation is of God. God's field is the world; the ministers who cultivate it are God's servants; the seed which they sow is God's word; it is the 'Sun of Righteousness' which sheds over it light and heat; it is the dew of Heaven which waters and nourishes it; it is the power of the Creator which has endowed the seed with those mysterious qualities, in virtue of which it yields to such influences, extending its roots, and shooting forth its stem, till its fruit bursts forth and ripens.

There is however, an essential difference between the soil of the human heart and that which the literal husbandman dresses. The ground is altogether passive to the hand of the cultivator. When operated upon, it exerts no *will*, either in withholding or giving out its powers. It is not so with man. He is a living soul. God gives him freedom of choice, and deals with him as a rational creature. He offers him the culture which may fit him for the garners of heaven, but he may reject it. It is this which renders him an accountable moral agent, and a proper subject of reward or punishment.

This remark applies not only to the first reception, but to the future growth of the Divine seed. We must be willing not only that the seed should take root, but that it should shoot forth and bear fruit. The seed may be sown, but it may lie unproductive in a cold and ungenial, because an unwilling, soil. We must *give* out our natural powers to cherish it. It is not enough that it is there. If we are satis-

fied with this, there is but too good reason to believe that the soil is bad. Its nature will be seen by the tendency of the seed to grow.

The sacred writers constantly refer to this progressive nature of Christian principle, and they express it by reference to all kinds of growth,—to the growth of the lower animals, as when it is said of believers, that 'they shall grow up like calves in the stall,' thriving under the hand of their feeder, and rapidly increasing in size and in strength; to human growth, as when we read of babes who cannot digest strong food, but must be fed with 'the milk of the word;' of children rising to the full stature of manhood; and of the aged head, surrounded with grey hairs as a crown of glory. Nor do we read less frequently of vegetable growth as an emblem of the progress of spiritual life,—it is compared to wheat which produces first the blade, then the ear, then the full corn in the ear; it is said to spring up like grass, and like willows by the water-courses; to flower as the lily; to produce fruit as the fig-tree and the vine.

Sometimes we see the vigour, the beauty, and the fertility thus indicated, most cheeringly exemplified in real life. There are not unfrequent instances in which the rapidity and luxuriance of spiritual growth fill all who witness it with admiration. The young convert passes so quickly through the various stages of the blade, the ear, and the full corn—of childhood, youth, and manhood—that they can scarcely be distinguished. He acquires, as if by intuition, mature and exalted views of the things of God; his heart becomes all at once, as it were, established in grace, and depends simply and entirely on the merits of his Redeemer; he is separated from the world, yet eager to do good, and to communicate instruction to those who still continue its slaves; he has already arrived at the full strength and wisdom of manhood, and adorns the doctrine of his Lord and Saviour.

But this is not the usual course. Alas! in how many instances do we observe a slowness of spiritual expansion, which marks how little energy there is in the will we exert to call

forth the powers of the soil. Notwithstanding all the advantages bestowed by the Heavenly Husbandman,—the means he employs to clear the field of its noxious produce, to manure it, to dress it, and to sow good seed,—how feeble the vegetation! Spring passes away, and summer arrives, yet the progress is scarcely perceptible. The sun shines, and the rain descends, but the soil is cold and barren. It seems as if the seasons would run their round, and winter, when it arrives, would find the plant as it was left in spring, without fruit, and of stinted growth.

But still there is encouragement. If the seed has really taken firm root, it will grow. We are 'God's Husbandry.' It is He who 'gives the increase.' The sky may frown, and tempests may blow, but He who said to the winds, 'Peace, be still,' will not forsake his own. If we have energies which we must exert, we have also strength to help us. He who has commanded us to grow in grace, has also promised that his grace shall be sufficient for us. We know to whom we may freely apply for aid. Christ came, not merely that we might have life, but that we 'might have it more abundantly.' If we are, indeed, under the culture of the Divine Husbandman, he will perfect the good work which he has begun in us. Let us, then, take courage, and open our blossoms to the genial influences which he sheds around us.

FIFTH WEEK—MONDAY.

VEGETABLE LIFE IN THE POLAR REGIONS.

Before leaving the subject of vegetation, it would be improper to omit some account of the state of that department of nature in the polar regions, which, in so many particulars, is remarkably contrasted with the same department under the other extreme of the tropics; and this matter has been so appropriately treated in the 'Edinburgh Cabinet Library,'* that

* Polar Seas and Regions, pp. 79—86.

I shall have little more to do than to curtail tha interesting account.

The vegetable world does not, in this dark and outer boundary of the earth, possess such an important and commanding character as the animal, which will afterwards be noticed. The Creator, without departing wholly from the system and laws he has prescribed to nature, could not clothe with vegetable verdure a soil which, for nine months in the year, is frozen as hard as a rock, and covered with snow many feet deep. The seeds of more genial climates, indeed, when sown during the short and bright summer, spring up, and wear for some time a promising appearance, but they are all nipt by the untimely winter. Still nature, in the northern regions, approaching the Arctic Zone, does employ resources suited to the peculiar circumstances of the climate.

The fir, the pine, and other trees of these regions, on being pierced, distil, not the balmy and fragrant gums of Arabia and India, but rich, thick, coarse juices, by which their interior heat has been preserved, and which, when prepared as pitch, tar, and turpentine, serve many valuable purposes of commerce. The lakes of North America are bordered with tall dark forests, which afford to more favoured countries an inexhaustible supply of valuable timber. Even their gloomy foliage, while the forests of the south are every autumn strewing the ground with their faded leaves, brave through the winter all the fury of the northern tempest.

But, before reaching the inclement sky of the Arctic Circle, this magnificent growth decays. Trees which, in a more southerly region, are the pride of the forest, dwindle into meagre and stunted shrubs. Beyond this circle, these monarchs of the wood, if they appear, rise only to the height of a few feet, throwing out lateral branches. On Melville Peninsula, dwarf willow, and the *Andromeda tetragona*, almost alone afford to the Esquimaux a scanty supply of wood for their arms and utensils. Considerable quantities of drift timber are, however, frequently found along the barren shores of the Arctic

Regions, supposed to have floated from the mouths of the Siberian and other northern rivers.

The plants which abound most in these dreary climates, belong to the tribes of mosses and lichens, the *cryptogamia* of Linnæus, the *acotyledones* of Jussieu. The meagre vegetation with which the arctic surface is covered, thus appears rather as if it were the produce of the rocks than of the soil. Yet the moss and lichen, which form the prevailing features, are not only copiously produced, but possess a nutritious and salutary quality, not displayed in more fortunate regions. One species of lichen (*L. rangiferinus*), forms, as it were, the main staff of life to the Laplander. It supports the rein-deer, and the rein-deer supports him. The lichen of Iceland, boiled in soup, or even converted into bread, is to the natives a substantial part of their subsistence. Farther north, where the depth of the snow, and the continuance of frost, drive the inhabitants to the shore and to animal food, these vegetables still afford support to the deer, and to the other quadrupeds, which they use as aliment. It is even with a species of moss that they trim their lamps. The fungus, or mushroom, which draws nourishment without the aid of a proper root, and the *filices*, or ferns, which consist only of one spreading leaf, the middle rib of which forms all their stalk, while their slender roots spread under the ground,—these find the means of existence even in Greenland.

The *fucus* tribes, comprehending nearly all the variety of marine botany, grow in vast abundance on the northern shores. These rude plants, which have little or no distinction of stem, root, or leaves, and whose fructification is often included within the substance of the frond, cover the Greenland coast with submarine meadows. The *confervæ*, too, with their numerous filaments, spring up in profusion.

A few plants, not belonging to this imperfect order of vegetation, embellish, during the short summer gleam, the northern fields. Under the bright influence of the sun at this season, indeed, some of the most beautiful among the floral tribe expand their petals. The ranunculus and anemone display

their rich and varied tints; several species of saxifrage flourish; and the yellow poppy has even a gaudy appearance, so that the poppy genus, which enriches the plains of Hindostan, is among the last to expire under the snows of the pole.

The nobler fruits do not ripen under this ungenial sky; yet shrubs, producing delicious berries, appear on the borders, at least, of the arctic zone, in great profusion. The northern Indians consider the fruit of a bush, called *aronia ovalis*, as the most agreeable food; besides which, they have the strawberry, the raspberry, the red wortleberry, and various others. Some of these are covered beneath the first snows of winter, which are supposed to mellow them, and which when dissolved by spring, show the berries still hanging on the branches, thus furnishing an early supply of grateful food, while the buds of all the others are bursting,—the whole producing a delightful impression, unknown to those who have not witnessed the desolation which immediately preceded.

These bleak regions enjoy a precious boon in the plants which act as an antidote to scurvy, and which defy the most severe cold of the arctic zone. The *cochlearia*, a thick-tufted juicy plant, of extreme fecundity, is emphatically called *scurvy-grass;* and different species of sorrel were found by Captain Parry flourishing under the snow, at the very farthest limit of vegetation.

Among the other phenomena of the arctic regions, may be mentioned that singular production which astonished the northern voyagers by the appearance of red snow. The following is the account of this appearance contained in the work which I am at present following:—"This singular aspect of a substance, with which we never fail to associate an idea of the purest and most radiant whiteness, has been ascertained to result from an assemblage of very minute vegetable bodies, belonging to the class of cryptogamic plants, and the natural order called *algæ*. They form the species named *protococcus nivalis*, by Agardh, which is synonymous with the *uredo nivalis* of Mr. Bauer. This plant seems by no means peculiar to the arctic snows, but occurs on limestone rocks on the island

of Lismore, in Scotland, as well as among the Alpine and other countries of Europe.'—'According to Captain Ross, the arctic mountains on which he observed the red snow, are about 600 feet high, and extend eight miles in length. The depth to which the colour penetrated has been variously stated by different observers. Some found that it descended many feet beneath the surface, while others never ascertained that it spread beyond one or two inches. There is no reason to suppose that the colouring matter itself, as well as the snow, is a meteorological product, although Humboldt certainly mentions a shower of red hail, which fell at Paramo de Guanacos, in South America. Moisture is, no doubt, essential to the production of this plant, as it is to all the other algæ; but when once formed, it seems to possess the power of continued and increasing vegetation, even over rocks and stones, with only an occasional supply of fluid.'*

A very different account has lately been given of the origin of red snow, which, if corroborated, will prove that the colouring matter is not a vegetable substance at all, but the excrement of a bird. Mr. Nicholson, who made an expedition to Regent's Bay in 1821, states, that he there observed crimson snow, and that it was evident, at first view, that the colouring matter lay on the surface. 'This substance,' says he, 'lay scattered here and there in small masses, bearing some resemblance to powdered cochineal, surrounded by a lighter shade, which was produced by the colouring matter being partly dissolved and diffused by the deliquescent snow. During this examination, our hats and upper garments were observed to be daubed with a substance of a similar red colour, and a moment's reflection convinced us that this was the excrement of the little hawk, myriads of which were continually flying over our heads, having their nests among the loose masses of granite. A ready explanation of the origin of red snow was now presented to us, and not a doubt remained in the mind of any that this was the correct one.'†

* Edinburgh Cabinet Library—Polar Seas and Regions, pp. 83, 84.

† Magazine of Natural History, vol. ii. p. 322.

It will be at once amusing and instructive, should this view be confirmed, to discover that a substance which has been soberly treated of by naturalists as a plant, the order of which has been settled, the name of which has been added to the calendar, and on which theories have been formed, should after all prove to be nothing more than animal excrement. The showers of blood which have sometimes alarmed nations by their fall, have, in like manner, been proved to be the red ejection of a species of butterfly.

It appears that the same substance which gives the red colour to snow, is occasionally detected, even during the warmth of summer, covering the brilliant white limestone of the plains. In the last named locality, it was discovered by the Baron Wrangler, in the province of Nerike. It was believed by him to be of a different species. If, after all, it be the excrement of a bird, it will not be surprising that it should be found in such different localities and seasons.

In reviewing this account of northern vegetation, it is interesting to remark the adaptations by which the general laws impressed on this department of nature are rendered consistent with the propagation and preservation of useful plants, under circumstances of climate which would render the raising of any of the ordinary kinds of the produce of the soil utterly hopeless. Among these provisions the reader would not fail to remark the thickened juices of the pine tribe, and their retention of their bristly foliage during the severity of winter, as means obviously intended to fit them for an ungenial climate; the abundance of mosses and lichens, endowed with qualities which render them nourishing food for man, or for the animals which contribute to his subsistence and comfort; the profusion of edible berries, and of salubrious grasses; and even the existence of beautiful flowers, which adorn the short-lived arctic summer. How edifying is it to find, that even in the most inhospitable climes, there are traces of a Father's care in the gifts which his bounty scatters.

FIFTH WEEK—TUESDAY.

CONNEXION BETWEEN THE VEGETABLE AND ANIMAL KINGDOMS.

In examining the character and properties of the vegetable creation, we have only been contemplating the various provisions which the Self-Existent has made for the subsistence of the animal creation. Without the existence of animated beings, vegetation, in all its remarkable varieties, would have been but an unmeaning pageant,—contrivance without an object,—mechanism without use,—a system of inventions and adaptations, amazing for their extent, their variety, and the depth of thought which they displayed, without any adequate end. It would be as if a magnificent and admirably furnished edifice were erected in a wilderness where there was no being to inhabit it. To communicate happiness, to inspire intelligence, and to call forth the exalted feelings of admiration and gratitude, or, in other words, to form sentient and rational beings, seem to be the only conceivable ends of creation. In the lower orders of animals, we observe the first obscure rudiments of such a design. These intentions we see still further developed in the faculties bestowed on man, and the circumstances in which he is placed in this sublunary state; but we must look beyond the present scene, and, aided by the light of revelation, take a glance into futurity, before we perceive the full scheme unfolded, or understand in what sense it is, that the great end of creation is to enable intelligent beings to glorify and enjoy their Creator.

Considered in this view, the first thing that attracts our attention is, that the organs of living creatures, and the peculiar chemical condition of their structure, are such as rendered the vegetable world necessary for their subsistence. The combination of their elements is so refined and complicated, as to require a succession of changes to fit the inorganic world for the necessary assimilation. In their crude state, the soil and the rocks, of which the earth is composed, are not capable of sustaining animal existence. The animal organs cannot ap-

propriate them, nor the animal powers digest them. It was necessary that these unorganized materials should undergo a process of selection and secretion before they could be suited to the support of the animal frame, and this office is assigned to the vegetable kingdom. It would be rash to say, that the Creator could not have so arranged the inorganic and animal worlds, as to make the one supply the wants of the other, without the intervention of intermediate changes; but in the arrangement actually adopted, there is an obvious and beautiful propriety, which marks it as the work of Supreme Intelligence. Vegetable existences extract, from the earth and atmosphere, the simple food furnished by nature, which consists chiefly of water, air, and carbonic acid; they elaborate these elements in their secretive organs, and causing them to undergo various modifications, convert them into aliments, which not only maintain their own vitality, but prepare them as the means of subsistence to the higher world of animals. These animals, again, are endowed with organs and functions capable of receiving such aliments, and converting them to their own use, so as to complete a system, wonderful at once for its simplicity and complexness. Such is the nature of the connexion between the two worlds of organized existences.

But, further, animal life might have been preserved in all its varieties by a single order of plants, had this been the whole intention. But how diversified are the forms and properties which have actually been produced! This was not without design. With regard to man, I have already pointed out very many advantages, embracing bodily vigour, mental improvement, and varied enjoyment, which result from such diversity. Others will appear at every step of our progress in contemplating the works of the Creator. With regard to the inferior animals, it is not so easy to speak with precision; but when it is remembered, that for all the varieties of the vegetable world, there are corresponding varieties among animals, we cannot withhold our conviction, that there are here contrivances and adaptations; and, on considering the character of the Creator as reflected from the works whose objects we

are enabled to trace, we feel warranted to add, that these contrivances and adaptations are wise and benevolent

It is to the animal world, then, that we must direct our view, if we would rightly estimate the mighty plan of creation. Vegetation, considered in its primary intention, is nothing more than a subservient contrivance, by which the animal frame shall be mechanically sustained, its organization developed, and its waste repaired. If with this be united varied enjoyment, arising from the exercise of the functions and senses, it is because a paternal God was pleased, in the exuberance of his bounty, to cause these subordinate arrangements to be directly conducive to the *ends* of animal existence, as well as to its means. But so far as the human race is concerned, even the pleasures which they derive from their connexion with the vegetable world are but subordinate to a much higher object, and can only be regarded as faint and scattered emanations from the Great Source of light and happiness, the foretaste of enjoyments unalloyed and endless.

Considered, then, as an end, the vegetable world was called into existence, and endowed with all its properties, exclusively with reference to the animal world; although the various relations and fitnesses, which subsist among the diversified orders of the former with regard to each other, may well form a subject of separate investigation. Vegetation exists for the use of living beings. Whatever properties it possesses are their inheritance, made and maintained expressly for them. Whether a plant be succulent or dry, hard or soft,—whether it be a grass, a flower, a shrub, or a tree,—whatever juices it selects from the earth,—whatever chemical changes these juices undergo in the leaves or other secretory organs,—whatever be the form it assumes, the colours it reflects, or the odour it exhales, it is not for itself or its fellows that it thus exists, but for another world, the world of sentient beings.

This, considered in itself, is a very remarkable arrangement, clearly indicating design; and when the particulars are examined, not only is this general view confirmed, but our admiration is greatly increased Here are two distinct

orders of existences in their general characters altogether different, yet so intimately connected, and so beautifully fitted to each other, that without the one the other could not exist at all, or would exist for no end. What gave rise to this remarkable adjustment, this necessary connexion? The answer is obvious:—A Contriving Mind, that could form comprehensive schemes, that could combine mighty powers naturally distinct, that could foresee and provide for conditions and relations vast, profound, and complicated.

FIFTH WEEK—WEDNESDAY.

THE SENSORIAL ORGANS.

In the volume on Spring, I took notice of the general principles which enter into the animal structure, such as the nature of the tendons, membranes, and ligaments, the functions of digestion, secretion, and muscular power, the circulation of the blood, &c. There are, however, some other important provisions in the animal frame, which have either not been mentioned at all, or have only been mentioned incidentally, and which now seem to invite particular notice, as introductory to a consideration of animal existences, in their state of full development. I allude chiefly to the different organs of sense, which shall form the subject of this paper.

Living creatures, being intended to perform voluntary actions, required some means of communication with the external world. This it has pleased Providence to afford them, by five different avenues. How many others might have been bestowed, in order to give them a complete acquaintance with natural things, it is impossible even to conjecture; yet while, on the one hand, we cannot but be aware that there are many existences, and many qualities of bodies, which lie beyond the ken of our senses, and which we can, therefore, no more perceive than a man born blind can perceive an object of vision, we ought gratefully to acknowledge that the

powers of sensation and perception actually allotted to us, are quite sufficient for all the purposes of sublunary life.

To be made sensible of the presence of bodies with which we are in immediate contact, seems to be the most simple mode of communication with the external world; which is effected by the sense of touch: But what a complicated and curious system does even this require. The seat of perception is in the brain; and, that the knowledge in question may be obtained, it was necessary that there should be messengers and channels of communication to it from every part of the body. This is accomplished by peculiar, and, in some respects, recondite contrivances, in what is called the nervous system. The sense of touch is chiefly confined to the outer surface of living bodies, because it is here that they come in contact with the external world. To understand the material mechanism through which it is perceived, it must be observed, that the skin consists of three parts, of which the *corium* forms the principal portion, and the cuticle the outermost layer, between which there occurs a thin layer of a substance called the *rete mucosum*. The corium is constructed of an intermixture of dense and tough fibres, through which a multitude of blood-vessels and nerves are interspersed; but its exterior surface is more vascular than any other part, exhibiting a fine and delicate net-work of vessels, named by anatomists the *vascular plexus*. It is here that the sensation of touch is principally situated; and we may infer that it contains the terminations of all the nervous filaments appropriated to this organ, which are here found to be divided to an extreme degree of minuteness. When examined with the microscope, this surface presents a great number of minute projections, which have received the name of *papillæ*, and which seem essential to the perfection of the sensation, as they are particularly conspicuous on those parts of the skin which are most essentially appropriated to this sense, such as the tongue, the lips, and, in human beings, also the tips of the fingers. To protect this structure of exquisite sensibility,

the cuticle is provided, an external covering entirely insensible, which envelopes the whole.

Such is a condensed account of the appearance and distribution of the nerves of touch; and I have only further to add, that this system may be traced till all its minute ramifications are concentrated and terminated in the brain. Beyond this all is mystery.

The senses of taste and smell are intended to convey impressions resulting from the chemical qualities of bodies, the one in the liquid or solid, the other in the gaseous state; and there appears to be a considerable analogy between these two senses; indeed, they may be said to be only peculiar modifications of the sensation of touch. The organ of taste is the surface of the tongue, the skin of which is furnished with a large proportion of blood-vessels and nerves, and here the vascular *plexus* is particularly conspicuous. It is intended, as its primary use, to guide animals in the choice of their food, and to warn them against the introduction of any noxious substance into the stomach, and is therefore placed in the mouth, through which aliment is received.

The sense of smell, on the other hand, is chiefly intended to protect the animal from the reception of noxious effluvia into the lungs, and hence it is usually made to occupy the beginning of the passages of respiration. It also materially assists the sense of taste, giving rise to what is called flavour; and, on this account, is placed in the immediate neighbourhood of the latter organ. The cavity of the nostrils is lined by a soft menbrane, constantly kept moist, which is supplied with numerous blood-vessels, and upon which are spread the ultimate ramifications of the olfactory nerves. In quadrupeds, as well as in man, these nerves are not collected into a single trunk, in their course towards the brain, but compose a great number of filaments, which pass separately into the cavity of the skull, through minute perforations in a plate of bone.

As there is an analogy between the three senses already mentioned, so there is this analogy between the other two, that it is by hearing and sight that animals chiefly acquire

the knowledge of the existence and movements of distant objects; sound results from certain tremulous or vibratory motions of the particles of an elastic medium, such as air or water, excited by some sudden impulse or concussion. These sonorous vibrations, being transmitted with great velocity, strike on the external ear, and then, after being concentrated in the internal passages of the organ, they are made to act on the filaments of a particular nerve, called the *acoustic* or *auditory* nerve, the structure of which is adapted to receive these particular impressions, and convey them to the brain.

Sight is the most refined and admirable of all the senses. It is intended to convey to animals a knowledge of the existence, situation, and colour of distant objects, which it does by means of the light reflected in all directions from these objects. The sensation is produced through the medium of the *retina* of the eye, as I have already had occasion to remark, on which the rays of light are thrown, in a concentrated form, and from which an immediate communication is established with the brain.

Such is, in few words, the material apparatus, through the medium of which the knowledge of external objects is conveyed to that principle in animals, whatever it may be, which possesses the faculty of sensation and perception. Even this necessarily slight and imperfect sketch is sufficient to impress the mind with a conviction that this diversified mechanism, and its results, could only originate in benevolent intention and profound contrivance. A more minute inquiry not only confirms this conviction, but, in proportion to the skill with which it is conducted, increases our admiration of the Divine Contriver, till we are lost in astonishment; and, as we stretch our mental powers to comprehend the subject, we become sensible of their utter inadequacy. I have, in a previous paper, adverted to the mechanical structure of the eye as an optical instrument; but there are very many circumstances of adjustment and construction, both in the instrument itself, and in the parts connected with it, no less obviously the result of design and consummate skill, to which I have not adverted

Take for example the crystalline lens. This central part in the eye of a codfish has been accurately analyzed by Sir David Brewster; and by the help of a powerful microscope, he assures us he has discovered that, minute as it is, and perfectly transparent, it is composed of upwards of five millions of fibres, which lock into one another by means of more than sixty-two thousand five hundred millions of teeth! This is only a single instance of those mechanical wonders which are to be found in the examination of every part of the animal frame, and especially of the sensorial organs. How infinitely, then, does the workmanship, in its details, as well as in its united effects, surpass all our powers of conception!

FIFTH WEEK—THURSDAY.

SENSATION AND PERCEPTION.

Having adverted to the organic structure by which the existence and qualities of external objects are perceived, some general observations seem to be called for, on the nature of that structure, and of the faculties connected with it. This agreeable task I shall perform, by making a free use of the observations of Dr. Roget,* to whom I have been so often indebted for information on all subjects connected with physiology.

To a person unused to reflection, the phenomena of sensation and perception may appear to require no elaborate investigation. That he may behold external objects, nothing more seems necessary than to direct his eyes towards them. He feels as if the sight of these objects were a necessary consequence of the motion of his eyeballs, and he never suspects that there can be any thing marvellous in the function of the eye, or that any other agent is concerned in the simple act of vision. If he wishes to ascertain the solidity of an object within his reach, he knows that he has but to stretch forth his hand,

* Bridgewater Treatise, Chapter on the Sensorial Functions, vol. ii.

and to feel in what degree it resists the pressure he gives it. No exertion even of this kind is required for hearing the voices of his companions, or for being apprized of the pealing of the distant thunder. Yet how much is really implied in all these apparently simple phenomena! Science, we see, has taught us, that these perceptions, far from being direct or intuitive are only the final results of a long series of operations, produced by agents of a most subtle nature, which act by curious and complicated laws, upon a refined organization, disposed in particular situations in our bodies, and adjusted with admirable art to receive their impressions, to modify and combine them in a certain order, and to convey them in regular succession, and without confusion, to the immediate seat of sensation.

Yet this process, complicated as it may appear, constitutes but the first stage of the entire function of *perception;* for, before the mind can arrive at a distinct knowledge of the presence and peculiar qualities of the external object which gives rise to the sensation, a long series of mental changes must intervene, and many intellectual operations must be performed. All these take place in such rapid succession, that, even when we include the movement of the limb, which is consequent on the perception, and which we naturally consider as part of the same action, the whole appears to occupy but a single instant. Upon a careful analysis of the phenomenon, however, it has been found that no less than twelve distinguishable kinds of changes must always intervene, in regular succession, between the action of the external object on the organ of sense, and the voluntary movement of the limb which it excites.

The external agents capable of affecting the different parts of the nervous system, so as to produce sensation, are of different kinds, and are governed by laws peculiar to themselves The structure of the organ is accordingly adapted, in each particular case, to receive the impressions made by such agents, and is modified in exact conformity to the laws they obey. Thus the retina is adapted to the action of light, and the

various parts of the eye through which the rays pass, before reaching the retina, are constructed with strict regard to the laws of optics. In like manner, the ear is so formed as to receive delicate impressions from those vibrations of the air which occassion sound. The function of each nerve of sense is determinate, and can be executed by no other part of the nervous system. The functions are not interchangable, as is the case with many others in animal life. No nerve but the optic nerve, and no part of that nerve except the retina, is capable, however impressed, of giving rise to the sensation of sight; no part of the nervous system, but the auditory nerve, can convey that of sound. The very same thing may be said, *mutatis mutandis*, of the three other senses. There is a peculiar set of nerves for tasting, another for smell, and another still for touch.

What is further worthy of remark is, that, in almost every case, the impression made on the sentient extremity of the appropriate nerve, is not the direct effect of the external body, but results from the agency of some intervening medium. There is always a portion of organic matter interposed between the object and the nerve on which the impression is made, so that these never come into direct contact. This is true even in the case of touch, where the organ is defended by the insensible cuticle, through which the impression is made, and by means of which it is duly modified. In the organs of taste and smell, too, the same observation applies, the nerves of these organs being not only defended by cuticle, but secured from too violent action, by a secretion expressly provided for that purpose. In the senses of hearing and vision, the changes which take place in the organs interposed between the external impressions and the nerves, are still more remarkable and important. The objects of these senses, as well as those of smell, being situated at a distance, produce their first impressions, by the aid of some medium, exterior to our bodies, through which their influence extends. Thus the air is the usual medium through which light, sound, and odour are conveyed to their respective organs. The

physical laws which regulate this medium, as well as those which belong to the agents themselves, must therefore be taken into account before we can fully understand the phenomena of sensation.

We have thus before us a most complicated system of contrivances and adaptations, which meet us on every side, and are full of instruction. Whether we consider the peculiar laws of the external world, by which they are fitted for the conveyance of the various sensations,—the laws of solid and liquid bodies, of sound, of light, of odoriferous effluvia, of the atmosphere;—or regard, in the organization of living bodies, the nerves of feeling, of taste, of smell, of hearing, and of sight, with the beautifully constructed mechanism, by means of which these nerves are enabled to perform their functions; or examine the nice adjustments by which such various and naturally distinct and unconnected objects are made to harmonize, coalesce, and co-operate, in producing the desired results; or, finally, attend to the nature of these results, as relates to the existence and happiness of sentient beings, we are at a loss what to admire most, and are irresistibly led to acknowledge and adore, in them all, the work of a Being transcendent in every conceivable perfection.

FIFTH WEEK—FRIDAY.

THE ARGONAUT AND NAUTILUS.*

HAVING, in the 'Winter' volume, considered animals in their dormant state, and, in that of 'Spring,' described their

* It may be proper, once for all, to acknowledge that I am chiefly indebted for the facts in natural history, of which I have made use in the following papers, to Goldsmith's animated Nature, the Bridgewater Treatises of Mr. Kirby on habits and instincts, and Dr. Roget on physiology, and to the works on Insects, Birds, &c., published in the Library of Useful Knowledge, as well as to the posthumous work of Dr. Macculloch, on the Attributes of God, published while this volume was preparing for the press.

reproductive powers, and instincts, it is my intention now to give some account of their faculties, qualities, and actions, in their full development, proceeding according to the plan I have uniformly adopted, and selecting such remarkable cases, in the various genera, as may serve best to illustrate the per fections and modes of operation of the Creator.

'The bed of the mighty ocean,' says Kirby, 'is not only planted with a variety of herbs, which afford pasture to many of its animal inhabitants; but it has other productions, which represent a forest of trees and shrubs, and are, strictly speaking, the first members of the zoological world, connecting it with the vegetable These are denominated *Zoophytes*, or animal plants, and *Polypes*. This last name has been adopted from Aristotle; with him, however, and the ancients, it is evidently used to designate the Argonaut and Nautilus of the moderns, and also to include some terrestrial shells. The Zoophytes are not confined to the ocean; every rivulet and stagnant ditch, or pool, affords to some kinds, most commonly denominated Polypes, and also to some sponges, their destined habitation. An infinite army of shell-fish, whether multivalve, bivalve, or univalve, also cover the bed of the ocean, or move in its waters; and some dance gaily on its surface with extended sails or dashing oars, when tempted by fair weather.'

Contenting myself with this general account of the inferior inhabitants of the ocean, I shall select only two species of this class for particular description, the first of which shall be taken from the tribe last alluded to,—I mean that of those which 'dance gaily on the surface of the ocean, with expanded sails and dashing oars.'

There are several kinds of shell animals, which use the apparatus nature has bestowed on them, to navigate the surface of the ocean. Of these are some species of *moluscans;* but there are two families of a different kind, whose formation and habits demand particular notice, I mean those of the Argonaut and Nautilus. These creatures belong to an order called *Cephalapods*, because their feet are placed in the same part of their bodies as their head. The various species of

this class are remarkable not only for their organization, form, and habits, but for their position in the animal kingdom. In their composition they seem to include elements from both the great divisions of that kingdom; from the vertebrates,—the beak, the eye, the tongue, an organ for hearing, the crop, the gizzard, and an analogue of the spine, with several other parts, enumerated by Cuvier; and from their own sub-kingdom, many of their remaining organs. We may descend to the very basis of the animal kingdom, for this first draught of the animal system; the sucker-bearing arms, seem to have their first outline in the fresh-water polypes; the lamellated tentacles, above and below the eyes, appear to lead to the antennæ of crustaceans and insects; and the numerous moluscan characters are obvious to every one. At the same time this singular creature exhibits many characters, both in its most extraordinary outward form, and in its internal organization, that are quite peculiar and *sui generis*, of which no animal at present known exhibits the slightest traces; I need refer only to its muscular apparatus, adapted to its unparalleled form; its system of circulation carried on, in the first order, by three distinct organs instead of one heart; and the wonderful complication of their tentacles, of the nerves that move them, and the vascular system that animates them.

This description, which I have considerably abridged from Mr. Kirby's account, shows a remarkable peculiarity in the class of animals to which the species we are considering belongs. They have each also peculiarities of their own; but they agree in one particular, that they each use their shells as boats, in which they transport themselves across the surface of the sea, erecting their sails to the wind, and plying their oars, as if they were the prototypes of the sailor and his vessel, with which he has made for himself a highway in the ocean, to unite the scattered family of man.

The shell of the argonaut, or paper nautilus, is spiral, involute, and membranous, and consists of a single apartment, or cell. It has a narrow keel, bordered on each side by a row of conical sharp tubercles; its sides are nearly flat, with nu-

merous angular waved ridges, its colour is white, with the kee often brown. It is very thin and brittle, resembling paper in its appearance. This animal is the nautilus of the ancients. It has eight arms, two of which are furnished at the extremities with an oval membrane, which it can at pleasure raise and expand to the gale, while the other six stretch over the sides of the shell, and are used as oars. Impelled by the breeze, this little animal, in its tender bark, has the appearance of a vessel under sail, and glides along the smooth surface of the ocean.

The great chambered nautilus is a native of the Indian seas, and frequently arrives at a very considerable size. The curious structure of its shell, consisting of distinct chambers, communicating with the rest by a small and short open tube, is particularly worthy of admiration. Into this tube, or syphon, a small tail-like process enters, which acts as a rudder, and instead of the tentacular legs, which distinguish the argonaut, it propels its skiff by a single expansive organ, somewhat similar to the foot of a snail.

It has been supposed by some, that the animal inhabiting the shell of the nautilus, is not its original owner, but has taken forcible possession of this commodious habitation, by destroying its original possessor. Such a supposition, however, appears to be unfounded.

Goldsmith describes this little interesting animal in his usual animated style, and though he seems to have confounded the two different species, the following account of its sailor-like habits will not fail to be agreeable. 'These animals, particularly those of the white light kind, are chiefly found in the Mediterranean, and there are scarcely any who have sailed on that sea, but must have often seen them. When the sea is calm, they are observed floating on the surface; some spreading their little sail; some rowing with their feet, as if for life and death; and others still, floating upon their mouths, like a ship with the keel upward. If taken while thus employed, and examined, the extraordinary mechanism of their limbs for sailing will appear more manifest. The nautilus is

furnished with eight feet, which issue near the mouth, and may as properly be called barbs; these are connected with each other by a thin skin, like that between the toes of a duck, but much thinner, and more transparent. Of these eight feet, thus connected, six are short, and these are held up as sails to catch the wind in sailing; the two others are longer, and are kept in the water, serving like paddles to steer their course by. When the weather is quite calm, and the animal is pursued from below, it is then seen expanding only a part of its sail, and rowing with the rest; whenever it is interrupted, or fears danger from above, it instantly furls the sail, catches in all its oars, turns its shell mouth downward, and immediately sinks to the bottom. Sometimes, also it is seen pumping the water from its leaky hulk; and, when unfit for sailing, it deserts its shell entirely. The forsaken hulk is seen floating along, till it dashes, by a kind of shipwreck, upon the rocks or the shore.'

There is something which wonderfully strikes the fancy in the instincts and functions of this tiny mariner; but there is, in reality, nothing more remarkable in its vessel, directed by a helm, propelled by oars, or scudding under the sail, than in those mechanical contrivances with which we are much more familiar, and the wisdom of which makes but little impression on our minds. That contrivances so nearly allied to those which human beings, in their skill and ingenuity, have adopted, should be found employed by the Creator, to facilitate the locomotion of a sea-snail, is certainly curious and surprising; but what is there in these contrivances that indicate design more listinely than the foot of a quadruped, or the wing of a bird? Or where shall we find, in any part of that apparatus, a skill more perfec than that which is to be discovered in the conformation of a single feather?

FIFTH WEEK—SATURDAY.

THE CORAL INSECT.

In glancing over the tribes of invertebrated animals, which form the lowest link in the scale of animal existence, another species which, on account of the singularity and importance of the structure it rears, seems worthy of arresting our attention, is the coral madrepore. Of the works of this remarkable family of the polypus class, I have already taken some notice, when adverting to the peculiar qualities of the cocoa-nut tree, as adapted to the newly-formed soil of coral islands.* A more particular description, however, will exhibit a striking proof of design, as regards the formation itself, which these animals produce.

Of the animal very little is known. It belongs to a class, of which the sponge, and the animalcule which forms the red coral, are varieties, and all the species of which, with one exception,† attach themselves to the solid rock, being deprived of the faculty of locomotion, and, in this particular, form a link between the animal and vegetable worlds. There is no scientific description of the coral madrepore; but Vincent Rosa, an Italian, has described an animalcule of the same class, and probably of similar conformation and habits, in the following terms:—'From every cell issues a cylindrical animal, resembling an intestine transversely wrinkled, about half an inch long, and two lines in diameter, and of which the upper extremity, or mouth, is surrounded by twenty-two very short tentacles. These animals, which are pendant, because this madrepore is always fixed under the projections of the rocks, and vibrates at the will of the waves, are always of a lively orange

* 'Spring,' p. 283.

† The floating polype is phosphoric, and emits so brilliant a light, that the fishermen can distinguish what fishes swim near it, and are thus directed to cast their nets.

colour; they contract as soon as they are touched, and they die upon being taken out of the water.'*

The general character of all the varieties of white coral is, that it consists of numerous radiating tubes, variously intercepted, all of which appear to issue from a common base. These are the receptacles of vast crowds of madrepores, which are busied at the surface of the formation, continually adding to the mass by their depositions, and stretching their tentacles from an innumerable aggregation of cells, to procure their food from the surrounding waters.

These tiny creatures, so insignificant individually, possess, in their collective capacity, a power which has astonished all who have turned their attention to the subject. Their countless multitudes, which are continually increasing, are incessantly at work in erecting fabrics of amazing extent, and vast importance in the economy of Nature. It would appear that, although they are divided into distinct individuals, they are, notwithstanding, all united together, so as to constitute one living mass, throughout the whole extent of the structure, thus forming, according to Kirby, the habitation of 'a many-headed and many-mouthed monster, which, at every oral orifice, is collecting means of still increasing its coral palace.'

Captain Beechy has given a most interesting account of the proceedings of these insects, in the formation of their mighty work; and he states some circumstances, connected with these proceedings, which prove them to be endowed with an instinct of an extraordinary nature, indicating a wisdom and forethought only referable to that class of faculties, which has already been often brought under our notice, and which Addison describes as 'an immediate impression from the First Mover, and the Divine energy acting in the creatures.'

In describing a coral formation called Ducies Island, he informs us that it takes the shape of a truncated cone, with the base downward, which can be demonstrated to be the form best calculated to resist the action of the water; and he

* Quoted in Kirby's Bridgewater Treatise, vol. i. p. 180.

thus proceeds:—'The north-eastern and south-western extremities are furnished with points, which project under water, with less inclination than the sides of the island, and break the sea before it can reach the barrier to the little lagoon formed within it. It is singular that these buttresses are opposed to the only two quarters whence their structure has to apprehend danger,—that on the north-east, from the constant action of the trade-wind, and that on the other extremity, from the long rolling swell from the south-west, so prevalent in these latitudes; and it is worthy of observation, that this barrier, which has the most powerful enemy to oppose, is carried out much farther, and with less abruptness, than the other.'

There is another circumstance, no less remarkable, mentioned by Amoureux, a natural historian, who has paid particular attention to the operation of the coral insect. 'Some,' says he, 'by their union or aggregation, form a long narrow ridge or reef, which extends uninterruptedly several degrees, opposing an immoveable rampart to the great currents of the sea, which it often traverses, the solidity and magnitude of which increases daily. Sometimes this line of madrepore rocks assumes a circular form. The polypes that inhabit it gradually elevate their rocky dwelling to the surface of the sea; working, then, in a sheltered basin, they, by little and little, fill up its voids, taking the precaution, however, to leave in the upper part of this impenetrable wall, openings by which the water can enter and retire, so as to renew itself, and furnish them with a constant supply of their aliment, and of the material with which they erect their habitation.'

In reference to a Final Cause, the observations of these authors are exceedingly striking. Here is an animalcule, bound to a particular locality, like a plant, and appearing scarcely to possess qualities superior to a vegetable, yet acting in concert with innumerable individuals of its species, not only to erect structures extending for hundreds of miles, but, in the mode of the combined operations, displaying an extent of scientific skill, which rivals the wisdom of the most expe-

rienced engineer, while the structures themselves incalculably exceed his power. When we observe such a society of animals, not only erecting their buildings in the form best calculated to resist the force of the ocean, but even raising buttresses and breakwaters in the places most liable to be assailed, and proportioning them, with consummate art, to the force of the current they have to resist; and when we farther find them, with remarkable precaution and forethought, leaving openings, where necessary, for the entrance and reflux of the tide, so as to keep up, by a constant renovation of the waters, an accession of food and of materials for their work,—how is it possible to withhold an acknowledgment, that the instincts thus endowed are derived from an intelligence not their own.

But, if we look further, and consider the ultimate effect of these structures,—if we trace them gradually rising from the deep bed of the ocean, till they fill up vast tracks lately occupied by a waste of waters, and lay the foundation of future islands and continents, the habitation of living beings, we shall discover new grounds of surprise and adoration. That these scarcely animated polypes should be capable of effecting all this, and should, in truth, have already to a considerable extent effected it, affords a singular view of the operations of Providence, and seems to corroborate those anticipations which originate in other sources, respecting future changes in the history of the human race. From considerations arising from the extraordinary vigour of reproduction in the animal world, and of the power of human industry and skill in increasing the supply of esculent vegetables, both by their selection and by the cultivation of the soil, I have shown the probability of a further rapid and most extensive multiplication of human beings, and of animals and vegetables fitted for their use; and, in the labours of the apparently insignificant coral animalcule, there seems to be still another means by which this beneficent end may be destined to be accomplished. It is true, that the progress of coral formations is slow; but the operation is on an immense scale, proceeding, in the warmer climates, in every region, and almost in every locali-

ty, where rock is to be found at the bottom of the ocean, at such a depth as to be within the influence of the light. A few ordinary shocks of an earthquake might, according to Mr. Lyell's observations, cause vast tracks of these already formed reefs and shoals quickly to emerge from the sea; and we know that, in this case, various provisions, elsewhere alluded to, are made by Providence, by which they would soon be covered with vegetation, and rendered habitable. We cannot, indeed, penetrate the future intentions of the Universal Governor; but we, at all events, behold, even in the lowest view we can take, a most wonderful and interesting manifestation of benevolent action. 'To me,' says Mr. Ellis, after an elaborate investigation of the history of living corallines, 'these disquisitions have opened up new scenes of wonder and astonishment, in contemplating how variously, how extensively, life is distributed through the universe of things; and it is possible that the facts here related, and these instances of Nature animated in a part hitherto unsuspected, may excite the like pleasing ideas in others; and, in minds more capable and penetrating, lead to further discoveries,—further proofs (should such yet be wanting) that One infinitely wise, good, and all-powerful Being, has made, and still upholds, the whole of what is good and perfect.'

SIXTH WEEK—SUNDAY.

THE INVISIBLE ARCHITECT.

Let us suppose that a skilful navigator, who ploughed the deep five hundred years ago, had taken soundings, and laid down accurate charts of the Southern Pacific, so that no islet, no shoal, no dangerous sunken rock, had failed to be noted by him. Let us further suppose him returned now to his ancient occupation, and afloat on his familiar waters. It would not be the new inventions about his modern rigged vessel,

the skill in taking observations from the heavens, not even the occasional apparition of a ship propelled by steam, and rolling its wheels upon the unstable floor, that would most amaze him. He would gaze around on leagues, where wave succeeding wave was all that erewhile met his vision, and behold islands in which active tribes now dwell under the shade of full-grown palms, and around whose swelling headlands the many-peopled canoe darts in all the activity of commerce,—islets where the young cocoa-nut already unfolds its leaves, and groups uncounted of flat green spots just emerging from the waters;—and in places over which his ancient bark had sailed in safety, he might see and hear the foaming breaker indicating that some new obstacle has arisen to impede the long roll of ocean, and to warn the mariner of the reef that lurks below. 'Whence come all these?' cries the astonished sailor. 'Has some star been shivered, and dropt its beautiful fragments into the sea, that was once so unbroken in its solitude? Have volcanic fires been at work, to heave up these blooming islands? Has some genius of mischief built these leagues of submarine dike, to work the doom of many a gallant vessel?'

Thou mayst inquire, thou ancient man, but the architect of all these fair islets will give thee no reply. Thou mayst resume thy plummet line, and take anew thy bearings, and again form an accurate chart for the guidance of thy fellows, and then go sleep again,—and when again five centuries have come and gone, thou mayst return, and then peradventure these islands will be formed into one vast continent, of which these dangerous reefs will constitute the noble promontories, and still around its coasts will have arisen new islets and new reefs; and smiling dwelling-places, thronged with human beings, shall arise where now the white waves curl upon the briny waters. 'But,' says the incredulous man of the sea, 'will God descend and resume the work of creation, that all this may be brought to pass?' No, the Creator will not resume his creation-work, he will only continue to exercise his preserving power, and his architects will accomplish all this.

'Still the architect appears not,—who and where is he? He is a mason, who not only uses stones for His building, but produces them. He knows nothing of mortar, or of cement, and yet his walls are as adamant. He has neither plane, nor chisel, nor trowel; there is no sound of hammer in His city. He erects mighty and enduring edifices, yet he has no mechanical power by which to raise His rocks to their summits. He can answer thee nothing,—no tongue, no eyes, no hands, no brains, has he, yet from the caves of old ocean has he raised that which fills you with admiration. Let me describe him, that you may admire with me the wonderful work of God.

He is a being scarcely belonging to the animal creation,—a minute pouch of organized matter, with no organ, save a few tentacles surrounding his mouth;—yet with these he is able to secrete calcareous particles from food collected amid the waters, and to transpire or regurgitate them so as to construct a limestone house. He is also empowered perpetually to send forth germs that repeat the same action; and thus, in process of time, by the combined efforts of millions, are groups of islands built up in the midst of the fluctuating ocean, which eventually arrive at the climax of their purpose, by becoming the permanent abode of man himself.

Here is, indeed, a marvellous edifice, and an invisible architect,—a process continually advancing, unaided and unnoticed by the world. But there is a more mysterious edifice, which has been in progress for six thousand years,—an edifice permament and beautiful, of which the world takes no account. Would you see it? It is but in fragments here. Its chief,—its foundation-stone was long since cut out of the mountain, without hands. The living stones with which its walls are built, are hewn and fitted in the quarry:—all their irregularities being there smoothed away, all their rough places broken off, they are polished and rendered beautiful before they are removed to be placed in the walls of that living temple, of which Solomon's was but a feeble type. But what, ask you, is this noble temple? and where is the busy quarry out of which its stones are hewn? Reader, it is

'God's building!' This world is the quarry;—you are perhaps yourself, or, at all events, you may, if you will, become one of those living stones, built up into a spiritual house. Have you ever been moulded under the warnings or invitations of the word of life? It is because the Master Builder has shed an effusion over the stone of your hard heart, and, thus prepared, it has yielded to the hand of the workman. Has conscience become quickened by the power of conviction, and rent off some darling sin? Then was a visible alteration produced in the surface of the stone. Has calamity broken away some inveterate evil, and left you suffering, but ductile, and praying, 'Lord, what wilt thou have me to do?' Then may you well believe that you are in the hands of the Workman, and that the process of fitting you for the spiritual building is going on in earnest. Take heed to it, watch for it, pray over it, lest the work be impeded, and the Master Builder cease to apply his forming hand to you. Muse much on that living temple:—Its foundation is laid in atoning blood,—blood shed for *many*;—and why not for you? Salvation it has for walls and bulwarks;—and there all the saved shall find their appropriate place. But if the builders of the temple on Mount Zion would have rejected a stone, whose proportions or whose polish failed to suit the designed place, how much more will the Holy One reject from among his living stones, any one whose dispositions and whose delights are unsuited to the heavenly edifice! In Christ Jesus, himself being the chief corner-stone, is all the building fitly framed together, and groweth unto an holy temple in the Lord; in whom all who love him are builded together for an habitation of God through the Spirit.

The work is silent, the world heeds it not; or if it hears, believes not in its reality; or again, if its reality is forced upon its conviction, it puts forth impious hands to pluck it down. But the building grows apace The eye of God is not withdrawn from his designed and glorious habitation. If each stone of that wondrous work is 'living,'—each instinct with the conscious presence and approbation of the Deity,—each

a temple for the Holy Spirit to inhabit, what must the grand united and completed temple be? Let not your heart die within you at the thought, as if you never could have an assigned place there. The scarcely living coral insect erects many a palace in the fathomless deep, because his Creator aids him,—he applies his powers to that for which they are designed, and prospers;—and will not God the Redeemer prosper you, when you apply yourself to do that for which you were bought with a price, namely to 'glorify him in your body and in your spirit, which are God's?'

As little will a single Christian, persecuted it may be, or tempted, or at best 'faint, yet pursuing,' give us a clear idea of the church triumphant, as a single cornice or stone of a pillar will represent the Vatican, or the labour of a single coralline enable us to form an idea of the far extending submarine labours of a colony of these animalcules. Examine the coral insects alone, and suppose each individual to act independently of the rest, and they will appear as nothing. Imagine them departing from their coral cradle, and diverging to right and left at the bottom of the deep, they might toil there till the world had become hoary, they might spread themselves over the sands and rocks as a carpet of moss is extended over the bosom of a mountain; but they would not ascend to the surface of the waters; they would form no island. Or supposing them building each alone, or in feeble communities, their paltry edifices would be snapt in sunder by every billow, and themselves dispersed, to form other and still feebler settlements in other localities.

This forms too correct a representation of the church militant. Instead of being joined in one spirit to our head, we are subdivided, estranged, imbittered, enfeebled. Instead of having the simple design, which we follow with singleness of heart, to strive for the extension of the edifice, until the whole world produce living stones, we are distracted by some inferior design, which we place foremost, because it is our own, or of our own contriving. Instead of looking stedfastly to Him who is the corner-stone, and aiming to extend His glory

to the ends of the earth, our efforts are cramped, and our strength paralyzed by upholding some Apollos or Cephas, who fills so large a section of our vision, as almost to exclude the view of the Redeemer.

Would that men aimed at the simplicity of purpose, and power of combination, which produce such amazing results in the insignificant coralline. Then how swiftly would that house not made with hands be completed! Then how many who are now left unhewn in the quarry, would come forth as living stones! Then how soon would that glorious consummation be achieved, on which the eye of the Master builder is set, and the 'head-stone of the building be brought forth with shoutings of Grace, grace unto it!' M. G. L. D.

SIXTH WEEK—MONDAY.

INSECT TRANSFORMATIONS.—THEIR COCOONS.—THE SILK-WORM.

The transformations which terrestrial insects undergo in the course of their existence, have been frequently alluded to in the preceding volumes; and some of them have been described, in reference to their hybernation and reproduction. The subject, however, is at once copious and interesting; and as this is the season when many of these metamorphoses take place, I willingly recur to it.

The first process to which I shall advert, as connected, in many insects, with these transformations, is that by which they prepare for themselves a shroud of silk for their temporary retreat, during the insensible state into which they are thrown while undergoing their most important changes. It is interesting to observe the various ways in which similar contrivances are adapted by the Creator to the fulfilment of different purposes The spider, as we have seen, spins and weaves nets to entrap her prey,—she also spins cocoons for her eggs; while all the caterpillars of butterflies, of moths, and, in general, of insects with four wings, spin silk of various de-

grees of fineness and strength, for enveloping their bodies like mummies, while in the chrysalis state.

In order to understand the nature of the apparatus by which a caterpillar spins its silk, it is to be recollected, that its whole interior structure differs from that of warm-blooded animals. It has, properly speaking, no heart, though a long tubular vessel, which runs along the back, and beats from twenty to a hundred times in the minute, has been called so. It differs also from the higher orders of animals, in having no brain, the nerves running along the body being only united by little knobs, or ganglions; and no lungs, their office being supplied by eighteen spiracles, situated along the sides. The spinning apparatus is placed near the mouth, and is connected with the silk bags, which are long, slender, floating vessels, containing a liquid gum. The bags are closed at their extremity, become wider toward the middle, and more slender toward the head, where they unite to form the spinning-tube or spinneret. The bags being in most cases longer than the body of the caterpillar, necessarily lie in a convoluted state, like the intestines of quadrupeds.

The following observations by the Abbé de la Pluche, will explain the nature and use of the spinneret:—'You may sometimes have seen, in the work-rooms of goldsmiths or gold-wire-drawers, certain iron plates, pierced with holes of different calibres, through which they draw gold and silver wire, in order to render it finer. The silk-worm has, under her mouth, such a kind of instrument, perforated with a pair of holes,* through which she draws two drops of the gum that fills her two bags. The instruments are like a pair of distaffs, for spinning the gum into a silken thread. She fixes the first drop of gum that issues, where she pleases, and then draws back her head, or lets herself fall, while the gum, continuing to flow, is drawn out and lengthened into a double stream. Upon being

* These two holes Lyonnet has discovered, on minute inspection, to be united into one. He has also discovered, that the united tube has a power of contraction and expansion, by which the insect can make the silk coarser or finer at pleasure.

exposed to the air, it immediately loses its fluidity, becomes dry, and acquires consistence and strength. She is never deceived in adjusting the dimensions of the apertures, or in calculating the proper thickness of the thread, but invariably makes the strength of it proportionable to the weight of her body.'*

The silk-worm, to a description of which I intend at present to confine myself, like most other moths, changes its skin four times during its growth, at which times it attaches itself, by its silk, to the place where it happens to be reposing, evidently to prevent the accident of wind or other causes from disturbing it while the operation of sloughing proceeds. About ten days after the fourth moulting, before which it has attained its full growth, and subsequent to which it has ceased to eat, and begun to diminish in size, having carefully sought for itself a safe retreat, it commences the operation of spinning itself a shroud. The author above quoted, gives the following description of this operation :—

'When my curiosity led me to know how they spun and placed their beautiful silk, I took one of them, and frequently removed the floss with which it first attempted to make itself a covering; and, as by this means I weakened it exceedingly, when it at last became tired of beginning anew, it fastened its threads on the first thing it encountered, and began to spin very regularly in my presence, bending its head up and down, and crossing on every side. It soon confined its movements to a very contracted space, and, by degrees, entirely surrounded itself with silk, and the remainder of its operations became invisible, though these may be understood, from examining the work after it is finished. In order to complete the structure, it must draw out of the gum-bag a more delicate silk, and then, with a stronger gum, bind all the inner threads over one another.

'Here, then, are three coverings, entirely different, which afford a succession of shelter. The outer loose silk, or floss, is for keeping out the rain; the fine silk in the middle, prevents

* Spectacle de la Nature, vol. i.

the wind from causing injury; and the glued silk, which composes the tapestry of the chamber where the insect lodges, repels both air and water, and prevents the intrusion of cold.

'After building her cocoon, she divests herself of her fourth skin, and is transformed into a chrysalis, and subsequently into a moth (*Bombyx mori*), when, without saw or centre-bit, she makes her way through the shell, the silk, and the floss; for the Being who teaches her how to build herself a place of rest, where the delicate limbs of the moth may be formed without interruption, instructs her also how to open a passage to escape.'

After giving some further minute particulars, the Abbé thus describes the change from the state of a chrysalis to that of a moth:—'Its nourishment is already in its stomach, and consists of a yellowish mucus, but gradually the rudiments of the moth unfold themselves,—the wings, the antennæ, and the legs, becoming solid. In about a fortnight or three weeks, a slight swelling in the chrysalis may be remarked, which at length produces a rupture in the membrane that covers it, and, by repeated efforts, the moth bursts through the leathery envelope into the chamber of the cocoon.' It thence forces its way into the open air.

It is the middle portion of the cocoon, after removing the floss or loose silk on the exterior, which is used in our manufactures. The insect must spin the whole of this without interruption, as we learn from the fact of the cocoons being generally unwound without breaking the thread. The length of an unbroken thread varies from 600 to 1000 feet; and as it is all spun double by the insect, it will amount to nearly 2000 feet of silk, the whole of which does not weigh above three grains and a half. Five pounds of silk from 10,000 cocoons, is considerably above the usual average. When we consider, therefore, the enormous quantity of silk which is used at present, the number of worms employed in producing it will almost exceed our comprehension. The manufacture

of silk, indeed, gives employment, and furnishes subsistence, to several millions of human beings.*

In ancient times the manufacture of silk was confined to the East Indies and China. The origin of this useful and beautiful substance was altogether unknown to the Roman authors, who have given ear to the most ridiculous fables respecting it. The insects at last were transported to Persia, and the Emperor Justinian introduced them into Constantinople, having obtained them by means of two monks, who concealed them in canes, and conveyed them to the island of Cos.

The scarcity of silk at no very distant date, is amusingly enough exemplified by the fact, that James I., before his accession to the crown of England, had to borrow of the Earl of Mar a pair of silk stockings to appear in before the English ambassador. The culture of silk, as an article of commerce, has been attempted in this country, but without success. It was successively introduced into Greece, Arabia, Spain, Italy, and France. It has also found its way into America, and is successfully cultivated in almost all the southern countries of the temperate zone. How curious is the Providential provision, by which a little insect, in following a natural instinct for its own preservation, is the means of furnishing to man one of his most esteemed and ornamental articles of clothing. This is, however, quite analogous to many other arrangements by which the comfort and improvement of the human race are promoted.

* The silk trade of Great Britain at present may be valued at 7,000,000*l* Sterling. The silk importations from France, through our Custom-House, amount to from 450,000*l* to 500,000; and by smuggling, to 250,000*l*. or 300,000*l* more, making in all from 750,000*l* to 800,000*l*. Manufactured silk, to the amount of 6,000,000*l* Sterling, is consumed in this country alone. What must be the amount throughout the world!—See *Ure's Philosophy of Manufactures*, pp. 246, 247.

SIXTH WEEK--TUESDAY.

INSECT TRANSFORMATIONS.--THEIR LARVA STATE.

The first state in which an insect appears when it is separated from the egg, is that of a caterpillar or grub, or of a maggot or worm, the former being furnished with feet, and the latter not. Both are by naturalists called *larvæ*. I shall not enter into any scientific details as to the nature of the animal in this state, but shall confine myself to the mention of one or two curious particulars.

With regard to the general appearance of the common caterpillar tribe, it is not easy to give a description which will answer them all. One of the most conspicuous of the class is thus graphically portrayed by Isaac Walton. 'The very colours of caterpillars, as one has observed, are elegant and beautiful. I shall, for a taste of the rest, describe one of them,* which I will some time the next month show you feeding on the willow-tree, and you shall find him punctually to answer this very description; his lips and mouth somewhat yellow; his eyes black as jet; his forehead purple; his feet and hinder parts green; his tail two-forked and black; the whole body stained with a kind of red spots, which run along the neck and shoulder blade, not unlike the form of St. Andrew's cross, or the letter X, made cross-wise, and a white line drawn down his back to his tail; all which adds much beauty to his whole body.' 'And it is to me observable,' this pleasing old writer continues, 'that at a fixed age this caterpillar gives over to eat, and towards winter comes to be covered over with a strange cell or crust, called an *aurelia*, and so lives a kind of dead life, without eating all the winter. And as others of several kinds turn to be several kinds of flies and vermin the spring following, so this caterpillar then turns to be a painted butterfly.'†

But there is another kind of *larva*, called a water-grub

* The press-moth.

† Walton's Angler, chap. v.

whose history is still more remarkable. One species is the produce of the gnat, the extraordinary instinct of which, in constructing a boat of its eggs, I have elsewhere described.* These eggs fall to the bottom of the water, where they remain till they are hatched. They then become grubs, whose element is the water. Their organs for breathing, which are very singular, are not situated in the head, as in the higher species of animals, nor in the sides, as in caterpillars, but in the tail. A tube, for the purpose of respiration, goes off from the terminal ring of the body at an angle. Its main buoys are this tube and its tail, both of which end in a sort of funnel, composed of hairs, in form of a star, anointed with oil, so as to repel the water. It is thus suspended with its tail upward, so as to reach the surface, and its head constantly immersed to the extent of its body in the water, where doubtless it procures its supplies of nourishment. If the oil be removed from these hairs, the grub will sink to the bottom. 'I have on these occasions,' says Swammerdam, 'observed it put its tail in its mouth, and afterwards draw it back, as a waterfowl will draw its feathers through its bill to prepare them for resisting water.'† The air, which enters into several openings in the breathing tube, passes onwards to two lateral windpipes, very similar to those of caterpillars. When it wishes to descend to the bottom of the water, it folds up the hairs of the funnel; but by means of its oil retains at their ends a globule of air; and when it wishes to re-ascend, it has only to open its air-funnel again.

There are other flies besides the gnat, whose grubs are aquatic, and one is mentioned by Swammerdam, that of the cameleon fly, whose air-funnel is extended to a considerable length from its terminal ring, and is fringed at the end with a beautiful star-like funnel of thirty feathers. These repel water like those of the gnat-grub, and at the point where the insect hangs suspended, a small dimple may be observed in the surface of the water. This grub also carries a globule of air with it, for the purpose of breathing, enclosed in its brush,

* 'Spring,' p. 129. † Biblia Naturæ, Part 1st, p. 154.

when it descends to the bottom, which may be seen there, shining like a brilliant pearl.

There is another two-winged fly, the grub of which seeks its food among ooze and mud, and whose breathing tube, while in the larva state, can at pleasure be elongated to twelve times the length of its body; the obvious intention being to keep up a communication with the external air, at such a depth as is necessary for it while seeking its food. 'For my part,' says the naturalist above mentioned, 'I dare boldly affirm, that the incomprehensible greatness of the Deity, manifests itself in these operations in a particular manner, and affords us an opportunity of examining, as it were, with our senses, the Divine Nature.'*

The larvæ of the dragon-fly procure air below the water, partly by means of an apparatus for pumping, and the water thus drawn in is thrown out again at its tail, with such force as to serve,—by the resistance of the stationary mass of water, and by creating a counter current,—as the means of its moving from place to place; while the reverberatory stream brings small water-insects within its reach. I have mentioned this grub, chiefly for the purpose of introducing an amusing account, given by Kirby and Spence, of the instruments by which it secures and masticates its food. 'The underlip is by far the largest organ of its mouth, which, when closed, it entirely conceals, and the animal not only retains, but actually seizes its prey, by means of a very singular pair of jaws, with which it is furnished. Conceive your underlip to be horny instead of fleshy, and to be elongated perpendicularly downwards, so as to wrap over your chin, and to extend to its bottom,—that this elongation is there expanded into a triangular convex plate, attached to it by a joint, so as to bend upwards again, and fold over the face as high as the nose, concealing not only the chin and the first mentioned elongation, but the mouth and part of the cheeks; conceive, moreover, that, at the upper end of this last-mentioned plate, are placed other convex ones, so broad as to cover the whole nose and temples; that

* Swammerdam, Part 2d, p. 51.

these can open at pleasure transversely like a pair of jaws, so as to expose the nose and mouth; and that their minor edges, where they meet, are cut into numerous sharp teeth or spines, or armed with one or more sharp claws;—you will then have as accurate an idea as my powers of description can give of the strange conformation of the underlip of the larvæ of the *Libellulina* [the dragon-fly,] which conceals the mouth and face, precisely as I have supposed a similar construction of your lip would do yours. You will probably admit that your own visage would present an appearance not very engaging, while concealed by such a mask; but it would strike still more awe into the spectators, were they to see you first open the two upper jaw plates, which would project from each temple, like the blinders of a horse; and next, having by means of the joint at your chin, let down the whole apparatus, and uncovered your face, employ them in seizing any food that presented itself, and conveying it to your mouth. Yet this procedure is that adopted by the larva of the dragon-fly, provided with this strange organ. While it is at rest, it applies close to and covers the face. When the insects would make use of it, they unfold it like an arm, catch the prey at which they aim by means of the mandible, form plates, and then partly refold it, so as to hold the prey to the mouth in a convenient position, for the operation of the two pairs of jaws with which they are provided. Reaumur once found one of them thus holding and devouring a large tadpole.'

These lively writers, in speaking of the mask-like appearance of this apparatus, jocosely add, 'If entomologists ever went to masquerades, they could not more effectually relieve the insipidity of such amusements, and attract the attention of the *demoiselles*,* than appearing at the supper-table with a *mask* of this construction, and serving themselves by its assistance.' For my part, I am inclined to take a more serious view, and considering these varied and wonderful contrivances and adaptations, as new proofs of Creative Wisdom, to

* Alluding to the French name of the dragon-fly.

bend in admiring adoration before Him whose works are so manifold, and whose resources are at once so skilful and so inexhaustible. 'Who knoweth not in all these that the hand of the Lord hath wrought this?'

SIXTH WEEK—WEDNESDAY.

INSECT TRANSFORMATIONS.—THEIR PUPA OR CHRYSALIS STATE.

'Country fellows, for a prize,' says Kirby, 'sometimes amuse the assembled inhabitants of a village by running races in sacks: take one of the most active and adroit of these, bind him hand and foot, suspend him by the bottom of his sack, head downward, to the branch of a lofty tree; make an opening in one side of the sack, and set him to extricate himself from it, to detach it from its hold, and suspend himself by his feet in its place. Though endowed with the suppleness of an Indian juggler, and promised his sack full of gold for a reward, you would set him on an absolute impossibility; yet this is what our caterpillars, instructed by a beneficent Creator, easily perform.'*

I have already shown how the silk-worm prepares for its pupa state, by weaving for itself a shroud; and this may be taken as an example of the process pursued by several other species of larvæ, such as those of the press-moth, the tent-makers, &c.; but the curious operations alluded to by Kirby, in the passage I have quoted, are most commonly employed by the insect tribes in the stage of transformation we are now considering. They suspend themselves by means of almost invisible silken filaments, formed into a little button thickly interlaced and strong, which they weave for themselves, and among the meshes of which they thrust their hinder pair of prolegs; taking secure hold by the numerous hooks with which these are fringed, and then fearlessly swinging themselves into the air with their heads downward. The most

* Introduction iii. p. 209.

difficult part of the process still remains; for the insect has to throw off its skin while thus suspended, together with the hooks by which it is attached, and this without losing its hold. The old skin is rent by the forcible bending round of the upper part of the body, a tedious and probably painful operation, in which it is engaged for a day, or sometimes even more. The rent being made, the included insect, by successively contracting and dilating the rings of its body, pushes off the skin by degrees from the head towards the tail, as the sack-racers mentioned by Kirby would disengage themselves from the sack in which they are enclosed.

In this position the excluded insect is at a considerable distance from the point of attachment to the meshes of silk, hanging on the empty slough. It has to reach that point, fix itself there, and disengage and cast away the sloughed skin. This operation, says Bonnet, causes a spectator to tremble for the consequences, for every moment seems to render its fall almost certain. It is, however, provided with means which enable it to effect its purpose: it can elongate and contract, at pleasure, the rings of its body. Laying hold of the nearest portion of the skin between two of its rings, as with a pair of pincers, it securely crawls along it, till it reaches the silk button. Having arrived at this station, it feels about with its tail for the silk, and inserts into its meshes the delicately formed hooks with which that part of its body is furnished; when, finding itself securely fixed, it again throws itself into the air, and hangs as formerly, with its head downward. It yet remains that the old skin be got rid of, the neighbourhood of which appears to be annoying. This it effects by repeated wrigglings, gyrations, and contortions of its body, which disengage the hooks of the prolegs from the silk, and cause it to fall to the ground.

There are other insects, which, manifesting the variety of resources belonging to the Author of Nature, make use of other expedients. Some of these not only fix themselves by the tail, but throw around their body, by a curious process, a girdle of silk, which binds them firmly to the spot selected,

frequently in a horizontal position. But instead of stopping to detail this difficult operation, which is performed in a different manner by distinct classes, I shall select an order whose plan of proceeding is altogether dissimilar. I allude to the numerous species of what are called common flies. Unlike most other larvæ, these never cast the skin, not even when they change into pupæ. The maggot of the common blow-fly, for example, when about to undergo its transformation, quits the carrion on which it has been feeding, and burrows, for an inch or two, into the first soft earth it can meet with. Here it draws in its body into a shorter compass, and the soft skin being thus condensed, it acquires in thickness what it loses in length. In this state it becomes hard and tough, like thin parchment, and of a dull reddish-brown colour. Within this skin, now converted into a leathern case, it undergoes its transformations, which have been minutely traced by Reaumur, but which I shall not enumerate, as this would lead into a somewhat tedious detail.

We are so apt to consider the processes of insect transformation as insignificant, merely on account of the smallness of the animal, that it is sometimes desirable to suppose a case in which bulk would appear to add to their importance. Mr. Rennie has, in the present instance, successfully availed himself of this device:—'Were such an extraordinary transformation as this,' says he, 'to happen to one of the larger animals, it would be held forth as altogether miraculous. Were a lion or an elephant, for example, to coil itself up into a ball, compressing its skin into twice the thickness, and half the extent, while it remained uniform in shape, and without joinings or openings; and, at the same time, were it entirely to separate its whole body from this skin, and lie within it as a kernel does in a nut, or a chick in an egg, throwing off its now useless tusks into a corner,—and then, after a space, should it acquire wings, break through the envelope, and take its flight through the air, there would be no bounds to our admiration. Yet the very same circumstances, in miniature, take place every day during summer, almost under the eye of every in

dividual, in the case of the blow-fly, without attracting the attention of one person in a million."*

Were we to follow up this idea, by supposing the various tribes of the insect world magnified to the dimensions of man, and the vertebrated animals, with which he is immediately associated, we should acquire more distinct views of their relative powers; but what a scene of wonders would be disclosed to our view. It would be pleasant to give way to our fancy in peopling the world with the monsters—strange and diverse, which would then meet us on every side. Looking only to one of the species we have been considering, we should see a creature large and fearful as a crocodile, for a time consuming every thing before it with the voracity of a hundred cattle, but presently becoming sick and refusing to eat; and then climbing the highest trees, spinning ropes from its bowels, weaving a net, and hanging itself up by the feet to the winds of heaven; and then again bursting its natural covering, coming forth to the open air, naked and in a new shape, and, in resuming its position, discovering a tact and agility which neither man nor quadruped could equal; once more we should observe this wonderful animal voluntarily suspended at the giddy height it had first assumed, and remaining exposed to the changing season till a new metamorphosis took place. Again it bursts its external covering; and now it comes forth a glorious being, shining with sapphire, emeralds, and gold, expanding its painted wings in the sun, and soaring joyously through the yielding air. Such would be the history of one class of existences; and a hundred more, equally surprising and extraordinary, would meet our view on every side.

But instead of pursuing this train, let us look at some of the faculties and operations of the insect tribes as compared with those of higher species. The flea can draw seventy or eighty times its own weight,† and it can leap to the distance of 200

* Insect Transformations, p. 282.

† Many wonderful exhibitions of the strength of the flea have been made, one of the first of which was in Cox's museum, about sixty or seventy years ago. Mr. Boverich, a London watchmaker, constructed a minute landau,

times its own length. It is, therefore, immensely stronger than a horse, in proportion to its size; and were a man able to equal the agility of this little animal, he could leap between 300 and 400 yards. But the cuckoo-spit froghopper has still greater elasticity of limbs, being able to leap more than 250 times its own length; and, to vie with this, a man of ordinary stature should vault through the air to the distance of a quarter of a mile! It has been remarked, that according to a similar mode of comparison, a cockchaffer is six times stronger than a horse; and Linnæus observes, that if an elephant was as strong in proportion as a stag-beetle, it would be able to tear up rocks and level mountains. The architecture of insects is not less remarkable than their strength and agility. It has been said, that the community of white ants erect a building 500 times their own height. Were our houses built on the same proportions, they would be twelve or fifteen times higher than the London Monument, and four or five times higher than the Pyramids of Egypt, with corresponding dimensions at the base: to such buildings St. Paul's would be but as a bee-hive!

'The minute observation,' says Mr. Rennie, in stating comparisons of this kind, 'by which such unexpected facts are discovered, has in all ages been a fertile source of ridicule for the wits, from the time when Aristophanes in his "Clouds" introduced Socrates measuring the leap of a flea, up to Peter Pindar's lampoon on "Sir Joseph Banks and the emperor butterfly." To all such flippant wit, we have merely to retort the question of the Abbé de la Pluche,—"If the Deity thought insects worthy of his divine skill in forming them, ought we to consider them beneath our notice?"'*

which opened and shut by springs, with the figures of six horses harnessed to it, and of a coachman on the box, a dog between his legs, four persons inside, two footmen behind it, and a postillion riding on one of the four horses, which were all easily dragged along by a single flea. Goldsmith remarks, that the feats of Samson would not, to a community of fleas, appear to be at all miraculous.

* Insect Transformations, p. 180.

SIXTH WEEK—THURSDAY.

INSECT TRANSFORMATIONS.—THEIR IMAGO OR PERFECT STATE.

While the insect is in its chrysalis state, the future fly is gradually formed and developed, and at last it again emerges to the light of day, by throwing off its external covering. The manner in which this is effected is far from uniform, but is suited, in each species, with remarkable care, to its individual peculiarities. The very singular manner in which the aquatic pupa of the gnat disengages itself on the surface of the water, making use of its coffin, during the operation, as a boat, has already been described.* One other instance may be mentioned, premising that most insects liberate themselves without external aid, being assisted by various prospective contrivances, among which may be named the swelling of their bodies, which breaks their covering at some convenient place, and enables them to make use of their natural confirmation in emerging, their bodies being generally composed of rings, which can be contracted or expanded at pleasure. The case I select is that of the ant; and I do so, because it affords an example of an insect which, being incapable of extricating itself from its pupa shell, is indebted for assistance, in this last change, to the already liberated inhabitants of the same nest. The younger Huber, in describing these pupæ, which are enclosed in a tissue spun by themselves, says, 'they have scarcely the power of moving; their covering is of too compact a texture, and formed of too strong a silk, to allow of their tearing it, without the assistance of the workers. But how do these indefatigable attendants ascertain the proper moment for this process? If they possessed the faculty of hearing, we might imagine they knew the fit time, from some noise produced in the interior of the prison, by the insects whose development is commenced; but there is no indication favouring this opinion; it is probable they have a knowledge of it from some

* 'Spring,' p. 130

slight movements that take place within, which they ascertain through the medium of their antennæ; for these organs are endowed with a sensibility of which it would be difficult to form a just idea.'

The following is the manner in which, as described by this author, the ants were observed to proceed:—'I noticed three or four, mounted on one of these cocoons, endeavouring to open it with their teeth, at that extremity answering to the head of the pupa. They began to thin it, by tearing away some threads of silk, where they wished to pierce it; and at length, by dint of pinching and biting this tissue, so extremely difficult to break, they formed in it a vast number of apertures. They afterwards attempted to enlarge these openings by tearing and drawing away the silk; but these efforts proving ineffectual, they passed one of their mandibles into the cocoon, through the apertures they had formed, and, by cutting each thread, one after the other, with great patience, at length effected a passage of a line in diameter in the superior part of the web.' They afterwards cut out a portion in the longitudinal direction of the cocoon, with their teeth alone, employing them as we employ scissors; and, as the work of extrication is a task of great labour, the ants relieved one another, till at last they were enabled to draw out the insect from its imprisonment. Their toil, however, was not yet completed; for the young ant, being enwrapped in another membrane, 'could neither fly nor walk, nor, without difficulty, stand.' Of this satin-like investment it was likewise stripped by the indefatigable assiduity of its followers; and, to crown all this care, which maternal attentions alone could equal, the first object of these kind guardians, was to supply the craving appetite of their young charge with necessary food.*

The providential intention of this arrangement is remarkable. The grub of the ant might doubtless have been formed with the power of extricating itself from its cocoon as well as the grubs of other insects; but, as it is destined to live in a community, all the members of which are united together for

* Huber on Ants, p. 88.

the common welfare, it seems to have been designed, by the instinct that has been noticed, and the necessity which required it, to form a bond between the young of the republic, and their seniors, which, from the first moment of their final transformation, should connect them together by those strong and tender sympathies that subsist among benefactors and the benefited. Such arrangements among animals living in community are not rare. We may trace them, in a greater or less degree, through all those tribes which associate together for a common interest, beginning with man himself; and they very strangely indicate not only the forethought but the benevolence of Him who has instilled the social instinct, and caused it to be productive of enjoyment to so many orders of beings.

As soon as the insect is extricated, it is found, in by far the greater number of instances, extending not only to many species, but also to numerous orders, to be furnished with wings, and destined to find its way through the atmosphere. That little creature which had hitherto grovelled in the earth, and whose powers of locomotion were so limited, has now acquired a power by which it can readily transport itself to considerable distances from place to place, and obtain varied enjoyments, to which, in the earlier stages of its existence, it was altogether a stranger. To this new condition some very peculiar circumstances are necessary; among these buoyancy is one of the most obvious We have already seen how this is provided for in birds.* Something similar, but corresponding to the peculiarities of their conformation, is found also in insects. It is by means of internal air-vessels that the requisite degree of lightness is obtained. We may not be able to trace very distinctly the peculiar mechanism by which this is effected, by reason of the minuteness of the organs; but one of the most remarkable phenomena which distinctly mark its existence, is the expansion of the body and wings, on the extrusion of the perfect insect from its pupa case. A very striking exemplification of this occurs in the transformation of the ant-lion, whose

* 'Spring.'—Relation of the Bodies of Birds to External Nature, p. 171.

singular instincts are so well known. When this creature has emerged from its cocoon, it only requires to expand its wings and body, in order to complete its transformation; but this is a process calculated to excite our highest admiration; for, though it is not at first more than half an inch in length, it almost instantaneously stretches out to an inch and a quarter, while its wings, which did not exceed the sixth part of an inch, acquire an immediate expansion of three inches.*

A similar increase of size is observable, to a greater or less degree, in all the insect tribes which rise into the air; and it is doubtless effected by the introduction of air into the receptacles of the body. Thus they become exceedingly light, in proportion to their bulk, and the power of floating in the atmosphere is greatly facilitated.

The expansion of the wings is also a subject worthy of observation. They are folded up, and sometimes doubled, in a very compressed state, while they remain in the chrysalis; but presently assume extraordinary dimensions, when exposed to the air. In the instance of the silk-worm moth, 'they expand so rapidly that it is not easy to trace their unfolding; for, in the space of a few minutes, they increase in dimensions about four-fold. Their spots and colours, at the same time, previously so small as to be scarcely discernible, become proportionally extended; so that, what, but a few minutes before, appeared as a number of confused and indistinct spots, acquires many varied beauties of colour and form.'†

The motions of insects, indicating enjoyment, are very remarkable; and, from this circumstance, Paley, with his usual felicity, has drawn an argument for the benevolence of the Deity. The following extract from a very interesting account, by Reaumur, of the appearance of the day-flies, or *ephemeræ*, on the banks of the Seine, illustrates the same truth. These in-

* The *lace-winged* fly exhibits a still more remarkable and not less sudden growth. The pupa of this insect is not bigger than a small pea, while the fly is nearly an inch in length, and the expanse of the wings about two inches.

† Insect Transformations, p. 341.

sects are destined to live but a few hours, yet their brief time seems full of ecstatic enjoyment. 'The countless numbers of ephemeræ,' says he, 'which swarmed over the water, can neither be conceived nor expressed. When snow falls thickest, and in the largest flakes, the air is never so completely full of them as that which we witnessed filled with ephemeræ.' It was evening; and Reaumur procured a torch which at once attracted them, and advantageously showed their gyrations. 'The light of the torch gave origin to a spectacle which enchanted every one who beheld it, and was altogether different from a meteorological shower; even the most stupid and unobserving of my domestics were never satisfied with gazing at it. No armillary sphere was ever formed of so many circular zones, in every possible direction, having the light for their common centre. Their number seemed to be infinite, crossing each other in all directions, and in every imaginable degree and inclination, all of which were more or less oblique. Each of these zones was composed of an unbroken string of ephemeræ, which followed each other close in the same line, as if thay had been tied together head and tail, resembling a piece of silver ribbon, deeply indented on its edges, and consisting of equal triangles placed end to end; so that the angles of those that followed, were supported by the base of those which preceded, the whole moving round with incredible velocity. This spectacle was caused by the wings of the insects, which alone could be distinguished. Each of these flies, after having described one or two orbits, fell to the earth, or into the water, though not in consequence of having been burned.'* Nothing could more distinctly indicate extreme delight, which seemed to end only when the joyous beings ceased to feel.

* Reaumur, Mem. vol. vi. p. 485.

SIXTH WEEK—FRIDAY.

INSECT INSTINCTS AND HABITS.—THE BUILDING SPIDER.

From considering the transformations of the insect tribes, we ascend to the instincts and habits of those varied and interesting families, and the first of these which I shall select for examination is the spider. There are several species of this remarkable insect, most of them possessing some peculiarity of habits, or organization, by which they are distinguished; but among these there is none either more singular, or better calculated to exhibit a proof of Designing Wisdom, in its instincts, than that class which has acquired the appropriate name of the trap-door or building spider. I shall follow the account of the celebrated M. V. Audoin, as abridged by Mr. Kirby in his Bridgewater Treatise.*

Some species of spiders, M. Audoin remarks, are gifted with a particular talent for building; they hollow out dens; they bore galleries; they elevate vaults; they build, as it were, subterranean bridges; they construct, also, entrances to their habitations, and adapt doors to them, which want nothing but bolts; for, without any exaggeration, they work upon a hinge, and are fitted to a frame.

The interior of their habitation, he continues, is not less remarkable for the extreme neatness which reigns there; whatever be the humidity of the soil in which they are constructed, water never penetrates them; the walls are nicely covered with tapestry of silk, having usually the lustre of satin, and almost always of a dazzling whiteness. He mentions only four species of the genus as at present known;—one which was found in the island of Naxas; another in Jamaica; a third in Montpellier; and a fourth, that which is the subject of his Memoir, in Corsica; to which Mr. Kirby adds a fifth species, found frequently by Mr. Bennet, in different parts of New South Wales.

* Vol. ii. pp. 287-293.

The habitations of the species in question are found in an argillaceous kind of red earth, in which they bore tubes about three inches in depth, and ten lines in width. The walls of these tubes are not left just as they are bored, but they are covered with a kind of mortar, sufficiently solid to be easily separated from the mass which surrounds it. If the tube is divided longitudinally, besides this rough-cast, it appears to be covered with a coat of fine mortar, which is as smooth and regular as if a trowel had been passed over it. This coat is very thin, and soft to the touch. But, before the adroit labourer lays it, she covers the coarser earthly plaster-work with some coarse web, upon which she glues her silken tapestry.

All this shows, that she is directed in her work by a wise Master; but the door that closes her apartment is still more remarkable in its structure. If her well was always left open, she would be subject to the intrusion of guests, that would not, at all times, be welcome or safe. Providence, therefore, has instructed her to fabricate a very secure trap-door, which closes the mouth of it. To judge of this door by its outward appearance, we should think it was formed of a mass of earth coarsely worked, and covered internally by a solid web; which would appear sufficiently wonderful for an animal that seems to have no special organ for constructing it; but if it is divided vertically, it will be found to be a much more complicated fabric than its outward aspect indicates, for it is formed of more than thirty layers of earth and web, emboxed, as it were, in each other, like a set of weights for small scales.

If these layers of web are examined, it will be seen that they all terminate in the hinge; so that the greater the volume of the door, the more powerful is the hinge. The frame in which the tube terminates above, and to which the door is adapted, is thick, and its thickness arises from the number of layers of which it consists, and which seem to correspond with those of the door; hence the formation of the door, the hinge, and the frame, seem to be a simultaneous operation, except that, in fabricating the first, the animal has to knead

the earth, as well as to spin the layers of web. By this admirable arrangement, these parts always correspond with each other, and the strength of the hinge, and the thickness of the frame, will always be proportioned to the weight of the door.

The more carefully we study the arrangement of these parts, the more perfect does the work appear. If we examine the circular margin of the door, we shall find that it slopes inwards, so that it is not a transverse section of a cylinder, but of a cone; and, on the other side, that the frame slopes outward, so that the door exactly applies to it. By this structure, when the door is closed, the tube is not distinguishable from the rest of the soil, and it is doubtless for the purpose of effecting this concealment that the door is formed with earth. Besides, by this structure, also, the animal can more readily open and shut the door. By its conical shape, it is much lighter than it would have been if cylindrical, and so more easily opened; and, by its external inequalities, and mixture of web, the spider can more easily lay hold of it with its claws. Whether she enters her tube or goes out, the door will shut of itself. This was proved by experiment; for though resistance, more or less, was experienced when it was opened, when left to itself it always fell down, and closed the aperture. The advantage of this structure to the spider is evident; for whether it darts out upon its prey, or retreats from an enemy, it is not delayed by having to shut its door.

The principal instruments by which this little animal performs her various operations, are her mandibles and her spinners. The former, besides the two rows of tubercles, between which, when unemployed, her claw or sting is folded, has, at the apex, or their inner side, a number of strong spines. As no one has ever seen her at work upon her habitation, it cannot be known exactly how these organs are employed in her various manipulations; but she probably makes use of her anterior legs along with them.

Though the particulars I have here stated, of the history and habits of these subterranean spiders, demonstrate, in every

respect, as far as we know them, the adaptation of means to an end, far above the intelligence of the animal that exhibits them, yet, fully to appreciate the wisdom, power, and goodness that created her, and instigated her to exercise these various arts, and to employ her power of spinning webs in building the structures necessary for her security, as well as for the capture of her prey, we ought to be witnesses to all her proceedings, which would probably instruct us more fully why she forms so deep a tube, and one so nicely covered with a peculiar tapestry from the mouth to the bottom.

SIXTH WEEK—SATURDAY.

INSECT INSTINCTS AND HABITS.—SPIDER'S WEB.

The power which the various races of spiders possess, of spinning webs to entrap their prey, is well known; but there are some curious particulars connected with this subject, which, though not so generally understood, are exceedingly interesting.

This little animal is a devourer of flies and other insects, and seems to be intended by the Creator to fulfil the important part of preserving the balance in that department of the animal creation with which it is connected, by keeping in check the tendency to multiply to an inconvenient degree. In all the orders of living beings such a provision is made, from the lion and hyena which roam the forest, spreading carnage and desolation around, to the invisible tyrant of the infusory tribes, which the solar microscope has disclosed, called, on account of its insatiable voracity, the water tiger. To accomplish this useful object, the spider is endowed with peculiar properties as well as instincts, the most remarkable of which is that of preparing and spreading nets to ensnare her prey.

The manner in which the material is formed for the fabrication of her net is as follows:—Immediately below the *anus*,

planted in a roundish depressed space, are six jointed teat-like organs. Four of these are pierced with a multitude of holes, so numerous, and so extremely fine, that there are in some species above a thousand in each of the divisions, a space itself not bigger than the head of a pin. From every one of the holes a thread proceeds, so that the very finest part of the web, which we can scarcely see, is not a single thread, but a cord composed of no fewer than *four thousand strands*, to use the technical language of the rope-maker. The line spun by the smallest spider, itself no bigger than a grain of sand, is so fine, that *four millions* of them put together would not exceed the thickness of a human hair; so that the number of strands which would be necessary to form a line of this thickness, would not be less than *sixteen thousand millions.* This is not more startling to a person unaccustomed to such investigations than it is true.

There is an obvious intention in the extreme minuteness of the original strands. Not only is the viscous matter of which the web is composed, by being exposed to the air in these exceedingly fine filaments, instantly dried, which seems necessary to its tenacity, but the line takes firmer hold at the places where it is attached to some solid object, when its thousands of ends are pressed upon it, than if this were done with a single end: and, what seems to be the chief intention, the line is much stronger in proportion to its thickness, by being formed of so many separate threads.

There are various ways in which the spider applies to her own use the thread she spins, some of them exceedingly artificial. One species employs them to enable them to mount into the air, another to cross streams, and another still, as we have seen, to form themselves a comfortable home; but the principal use to which this curious art is applied, is for the capture of their prey. There is a great variety in the manner in which the snares are constructed. That of the *geometrician*, is the most beautiful and symmetrical, being formed of lines diverging from a common centre, and crossed at minute intervals by other lines, drawn in spiral circumvolutions.

This spider frequents shrubs and hedges, where she spreads her net. The house-spider, on the other hand, weaves her web like a piece of gauze or fine muslin, with threads attached to the edges of the web, joining and crossing in various directions, and carried up often to the height of several feet. These lines intercept the insects flying across them, by which they become entangled, and, in struggling to get free, generally fall into the bosom of the net spread beneath to receive them. That she may keep quite out of sight, and not frighten away her victims, the spider often adds a little silken apartment below, or at one side of the web; and in order to know when any one is caught, she spins several threads from the edge of the net to that of her hole. These, by moving, give notice of what has happened, and serve as a bridge, by which she may run in a moment to any quarter where her prey is entangled.

Among all the remarkable instincts of this tribe, there is perhaps none so extraordinary as that of the species which build their nests under water. This creature is called the water-spider. She spins some loose threads, which she fastens to the leaves of water plants growing in a still pool. Among these threads she weaves for herself a cocoon, rendered impervious to water by covering the whole over with the gummy substance contained in her body. This apartment is about half the size of a pigeon's egg, and is formed with an opening below. Having covered her own body partly over with this gum, thus, in some mysterious manner, forming for herself an air-bag, she comes to the surface of the water, and draws in as much air as the bag will hold, which she conveys to her cell. This operation she repeats many times, till the cell is filled and expanded with air, the water being expelled; and during the operation, she usually swims upon her back, the air-bag, which is fixed to her abdomen, appearing like a bubble of quicksilver. In this diving-bell the spider lives, keeping herself quite dry, and having sufficient means of respiration, although under water. Here, too, she carries the prey

which she captures, diving below the water, and entering her habitation by the aperture underneath.

The whole operations of these insects are exceedingly curious, and there is yet one other circumstance which I have to mention: They are gifted with the faculty of walking in opposition to gravity, even upon glass, with their bodies inverted. According to the observations of Mr. Blackwall, this is not effected by producing atmospheric pressure by the adhesion of suckers, as is the case with flies, and some other creatures, but by a brush, formed of 'slender bristles, fringed on each side with exceedingly fine hairs, gradually diminishing in length as they approach its extremity, where they occur in such profusion as to form a thick brush on its superior surface.'* These brushes he first discovered on a living specimen of the largest species of this insect, called the bird-spider; and the same structure, as far as his researches were carried, he found in those species which can walk in counteraction of gravity upon glass. Solomon mentions the spider among 'the things that are little upon the earth, yet exceeding wise;' and one proof which he gives of her wisdom is, that 'she taketh hold with her hands.' There is, indeed, consummate wisdom in the contrivance by which she is enabled to do this, although the wisdom is not her own. It seems, however, not easy to understand how a brush so contrived as Mr. Blackwall describes, can bestow upon her that power to the extent in which she possesses it.

But the instruments with which the spider constructs her web, rather than those which she employs in locomotion, were probably the objects of Solomon's admiration. These I shall not stop to describe, as they would lead us too much into detail. I shall only observe, that they are among the most remarkable parts of her structure, containing, as they do, regularly formed carding and spinning machines, which the animal employs for extracting the matter from the teat-like organs already described, and drawing or weaving them into threads or webs at her pleasure. Entomologists have felt it an agree-

* Linnaen Transactions.

able task to dwell on the peculiarities of this class of beings; and they form a theme no less pleasing to those who delight to trace the Creator in his works.

SEVENTH WEEK—SUNDAY.

SPIRITUAL TRANSFORMATION.

The changes we have lately been considering are peculiar and strange; and, in contemplating them, we are apt to forget that this class of transformations forms only a particular modification of a law that is universal among organized existences. The change of a seed into a plant; its development till it produces leaves and flowers, and new seeds; its decay and resolution into its original elements; and the combination of these elements, again, into new forms of vegetable or animal life,—all these are as truly transformations, and, in their kind, as wonderful and admirable, as that of the insect egg into a worm, the worm into a chrysalis, and the chrysalis into a fly. Among animals the changes are still more striking. The embryo in the womb, and the egg which the mother hatches, have already undergone an astonishing transformation, and are destined to undergo other alterations of so extraordinary a nature, that they may well be compared to a metamorphosis. Being destined, in their earliest stage, to exist in a fluid, they are then possessed of organs, resembling the gills and corresponding organs of a fish, which disappear as the lungs are developed, and as the animal becomes fitted for breathing the vital air. Birth is a transformation as complete as the escape of an insect from its pupa-case. The creature appears in a new element, and has acquired new faculties adapted to its altered condition. As it grows, new developments take place, and corresponding powers and instincts are implanted; till at last the system decays, the powers of life give way; it dies, and returns to its kindred dust. Nor is this

the last change in one class of beings. The lower animals may, like plants, be destined to give forth the particles of which their bodies are composed, in contributing to the subsistence of other organized beings; and this, to a certain extent at least, is also true of man. But, besides this, the descendant of Adam has a peculiar privilege belonging to him, as a rational creature redeemed from death, and destined for immortality. There is an indestructible germ in his earthly part, and from this shall spring forth a celestial body; for 'the dead shall hear the voice of the Son of God, and they that hear shall live.'—It is the last and greatest transformation of his material frame.

But corresponding to these bodily metamorphoses, there is also a transformation of the mental powers, which takes place in those who are the objects of heavenly influences; nor is this without its analogy in the inferior creatures. Bodily transformations are always attended with some remarkable changes in the habits and functions of the animals which are subjected to them. The chick in the egg is quite a different being from the fowl; not merely in its corporeal frame, but in its capacities and its instincts; and, in the same manner, the change wrought in the redeemed at the resurrection, will doubtless be of amazing extent, comprising all the powers and faculties of the soul.

Before this final transformation, there is one of a nature scarcely less surprising, though more imperceptible, and generally more gradual, that passes upon those who, while they remain in the regions of time, are undergoing that process, which is finally to fit them for eternity; and who cease to be conformed to this world, being 'transformed by the renewing of their minds.'

The necessity of this change depends on a fact in the human constitution, undeniable in itself, yet so strange and unaccountable to all who reject the Gospel, that many ingenious attempts have been made to explain it away. I need scarcely observe, that I allude to the natural depravity of the human heart. Moral philosophers have exercised their talents

in describing what constitutes the perfection of the human character; and they have drawn many beautiful and facinating pictures of the mind of man, in the full development of its moral faculties. These are pictures, however, which, throughout the thousands of ages that have rolled away since man was called into existence, have never been realized, except in one individual, and *He more* than man. Why is this? Assuredly there are not wanting motives, strong, pressing, and paramount, to induce human beings to adorn their lives with those virtues and graces, which form the perfection of mankind, and which contribute so essentially to promote their happiness. Above all, these motives come home with tenfold weight to the heart of the professing Christian, who views this character embodied so beautifully in the life of Jesus. Yet he too remains, for the most part, unaffected by the very incentives, the force and importance of which he freely acknowledges; and when, at last, he feels them moving his heart, and influencing his conduct, he is forced to confess, that the change was not wrought by his own unaided exertions; that it was always superinduced on a powerless, and frequently rebellious, nature. For many revolving years, perhaps, a thousand impressive appeals had been made to his sense of duty, interest, and gratitude; but in vain. In vain had he been exhorted to obey his Creator and Redeemer; in vain had he been warned to flee from the wrath to come, and reminded of the glory, honour, and immortality which await believers in the world of spirits. These appeals perhaps roused him for a moment; but he fell again into his deep sleep, or he only remained awake to drown his convictions, by drinking the intoxicating cup of the world to the very dregs.

Neither has the warning voice of Providence power to gain admittance to the heart in its natural state. In what expressive language does God speak to our souls, in the events that are passing around us? How solemnly—how pathetically—does he warn us, that our treasure is not on earth! How painfully are we reminded that human strength is but a

shadow,—that pleasure is but a dream,—that life itself is but 'a vapour which appeareth for a little time, and then passeth away!' We see our hopes blasted, our enjoyments fading, our friends one by one perishing around us:—We shed a tear, we breathe a sigh, we say all is vanity, and then we return with greediness to those very pursuits of which we have beheld the emptiness and the termination.

But there are others, on whom these appeals and warnings have a very different effect. At one period of their lives, perhaps, they were as callous and unmoved as those whose case we have been considering. But the veil has been removed from their hearts, and they wonder at the weakness and perverseness of their former selves, and are sensible that 'there is no profit in those things of which they are ashamed.' They now realize to their souls the truths of the Gospel, and a new light is thrown on every thing they behold. To their unveiled eye,—heaven opens in its glory above them, and hell yawns in its horror beneath. The love of God is shed abroad in their hearts; gratitude to their Redeemer glows in every feeling of their soul; they hear the warning voice of Providence in every event of their lives. When they sorrow, it is not 'as others, who have no hope;' when they rejoice, it is a foretaste of the joy of angels. And their conduct corresponds with their feelings: They adorn the doctrine of their Lord and Saviour, by lives becoming the Gospel.

Whence is this difference,—so entire, so universal, so astonishing! How comes it that human beings should be so opposite to each other in their feelings, in their desires, in their affections,—in the whole tenor of their lives? Nay, how comes it that the very same individual should, at different periods of his life, be so opposite to his former self? Is it by his own efforts that a man is renewed in the spirit of his mind? If so, in what corner of the unregenerate heart does the power lie dormant? Why did he remain so long,—why do many remain to the end of their lives,—unaroused by the warnings of Providence however awful, and by the truths of the Gospel however earnestly urged?

Can reason answer this mysterious question? It will scarcely be alleged. But the declaration of Scripture is express. We are naturally, it tells us, in a state of spiritual stupor; and, just as the chrysalis, when it bursts its shell, passes from partial insensibility to the consciousness of a new and better existence, expanding its painted wings to the sun, and revelling in the varied delights which its Creator has provided for it, so it is with those human beings who have been brought from darkness and slavery into light and liberty. They have 'put off the old man and put on the new,' —they are 'born again,'—they have 'become new creatures,' —they are 'risen with Christ.'

And how has this change been effected? By the Spirit of God. It is he who has moved on the soul, as erewhile He moved on the face of the formless void, bringing order out of confusion. He 'creates us anew,' expelling earthly affections, warming us with new life, animating us with new desires, and enabling us to expatiate in new and more glorious regions,—to rise from earth to heaven, to claim alliance with celestial spirits, and to cast the anchor of our hopes in eternity.

SEVENTH WEEK—MONDAY.

INSECT INSTINCTS AND HABITS.—LEGIONARY AND SANGUINE ANTS.

I HAVE elsewhere noticed the care which the various species of ants take of their young, as well as the art with which some of them construct their habitations;* there are numerous other habits and instincts exhibited by different families of this very diversified class, which, however attractive, I cannot stop to examine. I shall confine myself to one feature in the history of two different species, equally peculiar and interesting.

The Legionary or Amazon ants, are a species not hitherto found in Britain, whose trade is war, and whose subsistence

* 'Spring,' pp. 146, 147.

depends on the success with which they invade and enslave ants of another class. The younger Huber has paid great attention to the warlike habits of this remarkable community, and the manner in which they procure labourers to provide for their domestic comforts; and the result of his investigations is so surprising, that were not his account confirmed by other naturalists of undoubted veracity and sound understanding, we might be inclined to believe that his imagination had affected the sobriety of his judgment. In abridging his narrative, I shall select those incidents which seem to be most illustrative of the peculiar instincts of this remarkable insect.

'On the 17th of June, 1804,' observes this pleasing writer, and accurate observer, 'whilst walking in the environs of Geneva, between four and five in the evening, I observed, close at my feet, traversing the road, a column of legionary ants. They moved with considerable rapidity, and occupied a space of from eight to ten inches in length, by three or four in breadth. They soon approached a nest inhabited by a colony of the negro ant, the dome of which rose above the grass. Some of the negroes were guarding the entrance; but, on the discovery of an approaching army, darted forth on the advancing legion. The alarm instantly spread into the interior, whence their companions rushed forth in multitudes to defend their homes. The legionaries, the bulk of whose army lay only at the distance of two paces, quickened their march, and, when they arrived at the hill, the whole battalion fell furiously upon the negroes, who, after an obstinate, though brief contest, fled to their subterranean galleries. The legionaries now ascended the dome, collected in crowds on the summit, and taking possession of the principal avenues, left some of their companions to excavate other openings in the exterior walls. They soon effected this, and through the breach the remainder of the army made their entrance; but, in about three or four minutes afterwards issued forth again, each carrying forth a pupa or grub, with which booty they retraced their route, in a straggling or irregular march, very different from the close orderly array they had before exhibited.'

Next day M. Huber witnessed successful attacks by this warlike tribe on two other negro hills in the same vicinity. He went to the encampment of the victors before their return, and was surprised to observe all around a great number of the very negro species which they had been attacking. 'I raised up a portion of the building,' he goes on to say, 'and upon still perceiving more, I conjectured that it was one of the encampments which had already been pillaged by the legionaries; but I was set right by the arrival at the entrance, of the very army I had been watching, laden with the trophies of victory. Its return excited no alarm among the negro ants, who, so far from offering opposition to the entrance of the triumphant army, I even observed approaching the warriors to caress them, and present them with food, as is the custom among their own species; whilst the legionaries, in turn consigned to them their prisoners, to be carried into the interior of the nest.'*

The curiosity of our naturalist being thus awakened, he directed his attention to the subject, and witnessed various other marauding excursions of a similar kind, and for a similar purpose. He observed, in some instances, that the negro army, after repeated defeats, as if conscious of their weakness, barricaded the several entrances to their encampment, with the evident intention of standing a regular siege. The manœuvre, however, never succeeded. Their formidable and persevering enemies soon effected a breach with their mandibles and their feet, and overcame all opposition. 'I was witness, says Huber, 'every day during summer to these invasions.'

Sometimes the legionaries attack the more warlike communities of the mining ant, generally with a similar result, but with more military art. Their phalanx is more compact in the advance, the onset is more furious, and they return after victory in more regular order.

Another species of ant, called the sanguine ant, on account of the blood-red colour of its head, thorax, and feet, is endowed

* Huber on Ants, p. 254.

with the same instinct as those whom Huber has denominated Legionary. These, however, differ in their mode of warfare. They do not send out numerous armies, or attempt to carry their point by a single impetuous onset, but wage the war in small predatory parties. Huber illustrates their mode of attack by a very interesting account of a regular battle between a marauding party of this kind, and a formidable encampment of the negro ants, in which a regular communication was kept up with the main body in the colony, and reinforcements were sent to the depredators, in proportion to the necessity of the case. On the other hand, the assailed, while they gave token of a vigorous resistance, looked to the safety of the young; and, in this respect, exhibited one of the most singular traits of insect prudence. 'Even long before success was at all dubious, they brought up the pupæ from their chambers under ground, and heaped them up on the other side of the nest from that where the invading army was making its chief assault, in order that they might be more conveniently carried off should the battle be lost. Their young females also took shelter on the same side. The attack ended with the rout of the negroes, who, in their retreat, seized each on a pupa, and conveyed it to a place of safety, while the victors entered their city, and plundered it of the remaining treasure.

One of the most remarkable circumstances respecting these expeditions is, that the only object of attack is to obtain possession of the young while in the insensible state of pupæ. The plunderers never make prisoners of the old negroes. The consequence is, that the captives become domesticated, without difficulty, in their new habitation, and give forth all their instincts for the benefit of their new owners. 'Developed in the enemy's encampment, they afterwards become household stewards and auxiliaries to the tribe with whom they are associated. Brought up in a strange nation, not only do they live socially with their captors, but bestow the greatest care on their larvæ and pupæ, their males and females, and even evince the same regard for themselves, transporting them

from one part of the colony to another, going in search of provisions for them, building their habitation, forming, as occasion requires, new galleries, and fulfilling the duties of sentinels, by guarding the exterior of their common abode, apparently not once suspecting that they live with those very insects which kidnapped them in their helpless and unconscious infancy. While the negro ants are engaged in these laborious employments, their masters rest tranquilly at the bottom of their subterranean city till the hour fixed for their expedition arrives.'

It is very remarkable, that the warrior ants seem incapable of either building a habitation for themselves, or even of procuring their food,—offices which are always performed by their slaves, on whom, therefore, they appear to depend, not only for a house and home, but even for existence; and so faithful are those devoted negroes, that they seem cheerfully to perform every office which can contribute to the comfort of their masters. Huber endeavoured to ascertain whether or not the warrior ants could subsist without the aid of their slaves: and, with that view, enclosed thirty of them, and some undeveloped young of both races, in a glass-box with earth and a little honey. They were totally unable to use any exertion for their own comfort and support. Their food remained untouched, and in two days one-half of them died of hunger. 'I commiserated their condition,' says the naturalist, 'and gave them one of their negro servants. This individual, alone and unassisted, established order, formed a chamber in the earth, gathered together the larvæ, extricated several young ants that were ready to quit the condition of pupæ; and, in a word, preserved the life of the remaining legionaries.'

Singular as this arrangement of Providence is, it is scarcely more so than that by which another species of ant has been taught to employ an entirely different race of insects as their domestic animals,—in the same manner as we do the cow,—feeding and protecting them, that they may extract from the bodies of these subject creatures a nourishing liquor for food.

While we experience surprise, and even perhaps some degree of revulsion of feeling, at the existence of a regular system of slavery among these insects,—a practice which we so justly condemn, as it exists among human beings,—it must be remembered, as Kirby and Spence most truly remark, that there is a wide difference in the two cases, since the subjection of these creatures does not, like human slavery, prove a source of misery; for their situation is little, if at all, different from what it would have been, had they never been carried from their native colony. They are altogether unconscious of degradation,—indeed, in some respects, they act as masters,—and they pursue their instincts, and exercise their faculties, as freely, and with as much enjoyment, as they would otherwise have done. Looking back, indeed, to the origin of this condition, we find rapine and spoliation on the part of the invaders,—privation, injury, and distress on the part of the invaded; but this is nothing more than a new mode in which the evil inherent in a fallen world is exhibited; and that evil is, not only in the way already mentioned, but by various other means, tempered and alleviated, if not compensated. How curious it is to observe, throughout universal Nature, as it exists in this sublunary state, the same chequered scene of good and evil, enjoyment and suffering! This condition comes more strikingly home to the mind, when, as in the present instance, we see the virtues and vices of human beings, as well as their joys and sorrows, imitated and acted over again, as it were, by inferior and irrational creatures.

SEVENTH WEEK—TUESDAY.

INSECT INSTINCTS AND HABITS.—THE LION ANT.

Of all the animals, evidently framed for the purpose of keeping the insect world in check by its predaceous habits, there is none so remarkable or so formidable as the lion-ant,—an insect which bears no alliance, except in some resemblance

of form, to that more interesting creature whose name it bears. The following description is chiefly given in the lively language of Goldsmith:—

The lion-ant is of the size of a common wood-louse, but somewhat broader. It has a pretty long head, and a roundish body, which becomes a little narrower towards the tail. The colour is a dirty grey, speckled with black, and the body is composed of several flat rings, which slip one upon another. It has six feet, four of which are fixed to the breast, and two to the neck. The head is small and flat, and in front there are two little smooth horns or feelers, which are hard, about a quarter of an inch long, and crooked at the ends. At the basis of the feelers there are two small black lively eyes, with which it can see very acutely, as is easily discovered by its starting from every thing that approaches.

To a form so unpromising, and apparently so ill provided for the purposes of rapacity, this animal unites one of the most ravenous appetites in nature: yet it has neither wings nor feet to enable it to advance on its prey. Legs, indeed, it has; but these only enable it to run backward; and it might die before it could make the smallest progressive motion. Thus, rapacious as it is, its prey must come to it, or it must starve.

But nature, that has denied it strength or swiftness, has given it an equivalent in cunning, so that no animal fares more sumptuously, without ever stirring from its retreat. For this purpose it chooses a dry sandy place at the foot of a wall, or under some shelter, in order to preserve its machinations from the rain; or, rather, I should say, that this appropriate station is chosen for it by Him who bestowed the instinct on the parent fly. The driest and most sandy spot is the most proper for it; because a heavy clogged earth would defeat its object. When it goes about to dig the hole where it takes its prey, it begins by bending the hinder part of its body, which is pointed, and thus works backward, making, after several attempts, a circular furrow, which serves to mark out the size of the hole it intends to form. Within the first furrow it digs a second, then a third, and afterwards others

Then it begins to deepen its hole, sinking lower and lower into the sand, which it throws with its horns and feelers towards the edges, as we see men throw up sand in a sand-pit. Thus, by repeating its labours all round, the sand is thrown up in a circle about the edge of the pit, until the hole is quite completed. The outer edge is always formed in a perfect circle, and the pit itself resembles the inside of an inverted funnel,—generally, for a full-grown insect, about two inches deep, and as much in diameter. When the animal meets with obstacles, it is most ingenious and assiduous in removing them. M. Bonnet mentions, that when a stone interrupts its labours, which it cannot remove like the sand by jerking it out, it crawls backwards, and thrusting its tail under it, is at great pains to get it balanced on its back, by an alternate motion of the rings composing its body. When it has succeeded in adjusting the stone, it crawls up the side of the pit with great care, and deposits its burden on the outside of the circle; this is a work, however, of great nicety, and the poor animal is frequently doomed to endure the torment of Sisyphus; but it is endowed with wonderful perseverance, and will not abandon its attempt, and commence a new pit, till after many unsuccesful attempts.

The work being thus with great labour finished, the insidious insect places itself in ambush, hiding itself in the bottom under the sand, in such a manner that its two horns encircle the bottom of the pit. All the sides of this pit-fall are made of the most loose and crumbling materials, so that scarce any insect can climb up that has once got down to the bottom. Apparently conscious of this, the lion-ant remains in patient expectation, ready to profit by that accident which throws some heedless little animal into its den. If, by misfortune, an ant, a wood louse, or a small caterpillar, walks too near the edge of the precipice, the sand gives way beneath its feet, and it falls to the bottom of the pit, where inevitable destruction awaits it. The fall of a single grain of sand gives the assassin notice at the bottom of its cave, and it never fails to make an effort to seize upon its prey; should the

destined victim prove too nimble, and get beyond reach of its claws, the lion-ant has another contrivance, still more wonderful than the former, for, by means of its broad head and feelers, it has a method of throwing up a shower of sand, which falls upon the little struggler, and once more crushes it down to the bottom. When the insect, therefore, has once fallen into the snare, its doom is sealed; its enemy seizes it with its hollow feelers, and darting them both into his body, sucks out all the hapless animal's juices with the utmost greediness.

When the prey is thus reduced to a husk, and nothing but the external form remains, the next care of the murderer is to remove the body from the cell. It takes up the wasted carcass with its feelers, and throws it, with wonderful strength, at least six inches from the edge of its hole, and then patiently sets about repairing the breaches which its fortifications had received in the last encounter. Nothing can abate its industry, its vigilance, its patience, or its rapacity. It will work for a week together to make its pit-fall; it will continue on the watch for more than a month, patiently expecting the approach of its prey; and if it comes in greater quantities than is needful, still the little voracious creature will quit the insect it has newly killed, and leave it half eaten, to attack another and another which falls within its reach. Although so voracious, the lion-ant is remarkably patient of hunger, some of the species have been kept in a box with sand for six months and upwards, without feeding at all.

When the lion-ant has attained a certain age, and the time of its change approaches, it burrows deeper in the sand, where it spins itself a cocoon. This cocoon is about half an inch in diameter; the outside is composed of sand and silk, the inside is lined with silk only, of a fine pearl colour, extremely delicate and beautiful. There it passes through its chrysalis state, like most other insects, and at last comes forth a beautiful fly, of the libellula or dragon-fly species, with a long slender body of a brown colour, a small head, large bright eyes, long slender legs, and four large transparent reticulated wings. The

remarkable expansion of its body and wings, in comparison with its former size, which so suddenly takes place after leaving its pupa-case, has already been noticed.

This insect, in its perfect state, holds the same place in the economy of nature as it did before. It serves as a check on the various tribes of flies, as it formerly did on those of the caterpillar family, and the other little creepers of its own class. It is the strongest and the most courageous of all winged insects; nor is there one of this genus, how large so ever, that it will not attack and devour. The blue-fly, the bee, the wasp and the hornet, make its constant prey, and even the butterfly, that spreads so large a wing, is often caught and treated without mercy. Its appetite seems to know no bounds; it spends the whole day in the pursuit, and has been seen to destroy three times its own size in the capture of a single hour. With its six claws it seizes its prey on the wing, which it tears easily to pieces with its powerful teeth. In all these habits, this insect resembles its congeners of the same species, though various kinds of the dragon-fly have a very different origin, being in their early stages inhabitants of the water.

SEVENTH WEEK—WEDNESDAY.

INSECT INSTINCTS AND HABITS.—THE QUEEN-BEE.

Bees have already been noticed both in the 'Winter' and 'Spring' volumes,—in the former to describe their hybernating, and in the latter, their reproductive instincts. But there is scarcely any thing in which these interesting little creatures do not strikingly exemplify the wisdom and the tender care of their Creator; and this paper shall be devoted to the consideration of some of their remaining instincts.

The mode of production of the queen-bee, its habits, and its relation to the rest of the hive, are circumstances which have not yet occupied our attention. In all these there is something exceedingly peculiar. Many gregarious animals, indeed,

have leaders; and there are some insects, such as ants, which like bees have a queen, the mother of the whole progeny. There are none, however, so far as has yet been ascertained, which can at all be compared, in their properties and functions, with the little insect just mentioned.

The queen-bee, although she can bear no rival near her throne, yet carefully deposits the eggs which are to form new queens, in the royal cells prepared for their reception. It is believed that there is no original difference between the egg of a queen and that of a worker,—that all working bees are females, but that they remain unproductive unless the larva be nursed in a particularly constructed cradle, and fed with a peculiar food. It is certain, at least, that a royal cell is different from all others, and that there is something peculiar in the food administered to the young queens in their infant state, as well as in their general mode of management; and it is not less certain, that the bees have it in their power to convert at pleasure the larva of a working-bee into a queen.

The following is the account given in the Edinburgh Encyclopedia, of the manner in which the remarkable conversion I have mentioned is effected:—'Immediately on the loss or removal of a queen, the whole hive is a scene of tumult and disorder;* the bees seem to anticipate their own destruc-

* This is not quite correct. Mr. Roget gives the following graphic account of what takes place in a hive on such occasions.—'When the queen-bee is forcibly taken away from the hive, the bees which are near her at the time do not soon appear sensible of her absence, and the labours of the hive are carried on as usual. It is seldom before the lapse of an hour that the working bees begin to manifest any symptoms of uneasiness; they are then observed to quit the larvæ which they had been feeding, and to run about in great agitation, to and fro, near the cell which the queen had occupied before her abduction. They then move over a wider circle, and on meeting with such of their companions as are not aware of the disaster, communicate the intelligence by crossing their antennæ, and striking lightly on them. The bees which receive the news become in their turn agitated, and conveying this feeling wherever they go, the alarm is soon participated by all the inhabitants of the hive. All rush forward with tumultuous precipitation, eagerly seeking their lost queen; but after continuing the search for some hours, and finding it to be fruitless, they appear resigned to their

tion, by the precaution they take to guard against it. Should there be neither eggs nor broods in the combs, they will infallibly perish; their instinctive faculties are lost; they have no object for which their labours are united; they cease to collect honey or prepare wax, and in a short time they disappear and die.

'But if there be brood in the combs, the industry of the bees continues unabated; for, by the proceeding that they follow, they know that their loss will be repaired. Having selected a worm three days old, or less, they sacrifice three of the contiguous cells, that the cell of the worm may be formed into one adapted to breed a queen. They next supply it with the necessary food; which is not the common farina, pollen, or bee-bread, on which the young of workers feed, but a peculiar kind of paste or jelly, of a pungent taste, which is reserved for the queen alone. A cylindrical enclosure is raised around the worm, whereby its cell becomes a perfect tube, with its original rhomboidal bottom, for that part remains untouched. Were it injured, the fabric of the other three cells on the opposite side of the comb would be deranged, which would be a needless waste. The cell is still horizontal, like the rest of the combs, and thus remains during the first three days of the existence of the worm; but the bees, in prosecuting the enlargement, alter its direction, and form it to hang perpendicularly, as all those cells do which have been inhabited by queens. In performing this essential part of the operation, they do not scruple to destroy the worms surrounding the tube, and use the wax of their cells in constructing the new part, which they apply at right angles to the first, working downwards. The cell is then of a pyramidal figure, usually near the edges of the combs. It insensibly decreases from the base, and is closed at the top, when the included worm is ready to undergo its transformation to a nymp. When reaching maturity, the seal is broken, and a queen comes forth qualified to fulfil every indispensable function on which the

misfortune; the noisy tumult subsides, and the bees quietly resume their labours.'—*Bridgewater Treatise*, vol. ii. pp. 287, 288.

preservation of so many thousand lives depends. Working bees have therefore the power of effecting the metamorphosis of one of their own species, to avert the effects of a loss which would prove the utter ruin of the whole colony.'*

Nothing can easily be conceived more curious than the change which is thus effected. That, by a certain mode of management which instinct points out, an insect should be so changed in its form, in its functions, and in its habits, is beyond measure surprising. When we think of the extent of the change, we shall find nothing in nature analogous to it. The same animal, which, had its growth and training proceeded in the usual way, would have been one individual among many thousands secreting wax, building cells, flying abroad on busy wings to collect honey or pollen, or remaining at home to dress the comb, and nurse the young, is deprived of all these powers and instincts, and in their place acquires a new nature, which renders her an absolute monarch, whom the thousands that would otherwise have been her equals revere and obey; which confines her, except on one or two peculiar and pressing occasions, to the precincts of her little kingdom; which makes her the mother of the succeeding generation and of new communities; which elevates her, in short, to be the presiding genius on whom the prosperity and the very existence of the whole commonwealth depend. All this is a mystery, into the physiology of which the naturalist shall in vain attempt to penetrate. But its *final cause* is clear and indisputable. The destinies of the whole depend on the life of their queen. The Creator, who willed this, foresaw and provided against the consequences which would ensue were there no means of repairing the loss of this precious life. The contrivance, however mysterious, is admirable and efficient,—worthy of the Divine wisdom and benevolence, from which it proceeds.

Swarming is another subject of great interest, with regard to the causes of which much remains unexplained. It has been ascertained by Huber, that the first swarm is uniformly

* Edinburgh Encyclopedia—article Bee, p. 407.

led out by the old queen, at a time when she has stocked the hive with numerous eggs, and especially when there are several young queens approaching maturity. All the subsequent swarms are led out by young queens. One chief phenomenon which precedes swarming, consists in the agitation of the queen. She is suddenly affected from some unknown cause, it may be from a consciousness which she has acquired by sounds emitted from the royal cells, or otherwise, of the approaching period of the production of rivals. She hastily traverses the combs, abandoning that slow and dignified progress which she usually maintains; her agitation is communicated to the bees; they crowd to the outlets of the hive; and the queen escaping first, they hasten in great numbers to follow her. She generally takes but a short flight, and wherever she settles, she is surrounded by her faithful and devoted subjects.

This is the process.—And here again, although the physical cause is obscure, the Creative intention is obvious.—A queen is said to lay from 50,000 to 100,000 eggs in a single season, all of which may produce living bees. No ordinary hive, or, in their wild state, no hollow of a decaying tree, in which they usually fix their habitation, is sufficient to contain such numbers with advantage. They must separate therefore into distinct communities; and that this may be effected in proper time, and under advantageous circumstances, this peculiar instinct is bestowed.

There are many other instincts and functions belonging to this interesting creature, besides those already mentioned, which it would be pleasing to enumerate, such as the nature of the means by which they communicate information; the remarkable power of stilling and confounding the hive, which is possessed by the queen in the emission of certain sounds; the qualities of wax and of honey; the precautions adopted by bees to obviate danger; the instinctive antipathies and affections both of the queen and her subjects. On these, however, I must not at present enlarge. Books have been written

on the subject, and have not exhausted it: and I shall only add, that the whole history is impressed with traces of a Divine hand.

SEVENTH WEEK—THURSDAY.

VERTEBRATED ANIMALS.—THEIR PHYSIOLOGICAL CHARACTER.

The classes of living beings which I have hitherto been considering, are those belonging to the lowest species of existences, which possess no strong internal framework on which the living fibre may be sustained, but, when strength is required, are fitted by their intelligent Creator with external apparatus for that purpose. Higher orders, however, were destined to inhabit this terraqueous globe, whose habits and functions seem to be incompatible with this mode of construction, and hence a complete and radical change of the animal organization was resorted to, and the great division of vertebrated animals took its origin.

The observations of Dr. Roget on this subject are so sensible and so appropriate, that I am sure I cannot do any thing more acceptable than to use his words. If it be pleasing, says this philosopher, to trace the footsteps of nature in constructions so infinitely varied as those of the lower animals, and to follow the gradations of ascent from the zoophyte to the winged insect, which exhibits the greatest perfection compatible with the restricted dimensions of that class of beings, still more interesting must be the study of those more elaborate efforts of Creative power, which are displayed on a wider field in the higher orders of the animal kingdom. In the various tribes of beings which are now to come before us, we find Nature proceeding to display more refined developments in her system of organization, resorting to new models of structure, on a scale of greater magnitude than before; devising new plans of economy, calculated for more extended periods of duration; and adopting new arrangements of organs, fitted

for the exercise of a higher order of faculties. The result of these more elaborate constructions is seen in the vast series of *vertebrated animals*, which comprises a well-marked division of zoology, comprehending all the larger species that exist on the globe, in whatever climate or element they may be found, and including man himself, placed, as he unquestionably is, at the summit of the scale,—the undisputed lord of the Creation.

A remarkable affinity of structure prevails throughout the whole of this extensive assemblage of beings. Whatever may be the size or the external form of these animals, whatever the activity or sluggishness of their movements, whether they be inhabitants of the land, the waters, or the air, a striking similitude may be traced both in the disposition of their vital organs, and in the construction of the solid frame-work, or skeleton, which sustains and protects their fabric. The quadruped, the bird, the tortoise, the serpent, and the fish, however they may differ in subordinate details of organization, are yet constructed on one uniform principle, and appear like varied copies from the same original model. In no instance do they present structures which are altogether isolated, or can be regarded as the results of separate and independent formations.

In proceeding from the contemplation of the structures of articulated to those of vertebrated animals, we appear to pass, by a rapid excursive flight, from one great continent to another, separated by an immense gulf, containing no intermediate islands from which we might gather indications of those tracts of land having been originally connected. At the very first sight, indeed, the general fabrics of these two descriptions of animals appear to have been constructed on opposite principles; for, in the articulated, as we have already seen, the softer parts are internal, and are enclosed in a solid crust, or shell, or horny covering, answering at once the purposes of protection and mechanical support, and furnishing extensive surfaces for the attachment of the organs of motion. But in the *vertebrata*, the solid frame-work which serves these

purposes, occupies, for the most part an internal situation, constituting a true-jointed skeleton, which is surrounded by the softer organs, and to which the muscles, destined to move their several parts, are attached. The office of external defence is entrusted solely to the integuments, and their different appendages.

Such is the general character of the arrangements which Nature has here adopted; from which, however, she has occasionally deviated with respect to some important organs of extremely delicate texture, and which require to be shielded from the slightest pressure. This occurs with regard to the brain and the spinal marrow, which are specially guarded by a bony structure, enclosing them on every side, and forming an impenetrable case for their protection. The solid mass of bone thus provided to defend the brain, gives also the opportunity of lodging safely the delicate apparatus subservient to the finer senses, namely, those of sight, of hearing, and of smell. The security which these organs derive from this protection, allows of their being carried to a higher degree of improvement than could be attained in the lower orders.

There is also another advantage, of considerable moment, which results from the internal situation of the skeleton, namely, that it admits of an indefinite extension by growth, without interfering with the corresponding enlargement of the softer organs; for, in all the instances in which this arrangement is reversed, that is, whenever the enclosing surfaces become solid, and can no longer yield to the dilatation of the contained organs, no alternative remains but that of breaking up the exterior case, and wholly casting it off, to make room for the further growth of the animal; after which operation, it has to be replaced by another covering of larger dimensions. This operation is generally required to be performed a great number of times, before the animal can acquire the size it is destined to attain. Hence the perpetual moultings of the caterpillar; hence the repeated castings of the shells of the crustacea; and hence, also the successive metamorphoses of the

insect. Nothing of this kind takes place among the vertebrata, where all the organs are developed in regular and harmonious succession, without the slightest mutual interference, and without those vicissitudes of action and of torpidity, which we witness in the chequered existence of the insect.*

SEVENTH WEEK—FRIDAY.

REPTILES.—THE TORTOISE.

In passing from invertebrated to vertebrated animals, a great step, as we have seen, is taken in animated nature. The whole type of the physiological structure is changed, and new principles are introduced. There are, notwithstanding, various resemblances and identical organs, which manifest the same great Artificer. There are, in both classes, organs of sight, of hearing, of smell, and of taste; there is the sense of feeling diffused in both cases over the whole body; the living fibre in both is of a similar nature; the animal exists and grows in both instances by consuming and digesting food; and it has powers of locomotion by means of legs and wings, or in some species, by means of movements or writhings in the body. In all these, and in very many other particulars, there is an obvious analogy, and besides this, there is, in various species, an approach in form and in habits, which seems to be intended as a connecting link between the two great departments of living beings.

In this higher order of animated nature, as well as in the lowest, there is an ascending scale, and as the simplest form of vertebrated animals is to be found in the waters, physiologists have agreed in introducing fishes into their systems, as the first and lowest class. It will, however, correspond better with my plan to proceed at present with the lower animals, belonging to the land; and, of these, I commence with a species of reptile, allied both to land and water, which differs

* Dr. Roget's Bridgewater Treatise, vol. i. pp. 261-265

from all other orders of vertebrated animals, and approaches in its form nearer than any other to animals very low in the scale of organization, while it retains the essential characters of its own natural division;—I allude to the order *chelonia*, which comprises all the tribes of tortoises and turtles. This order, instead of presenting a skeleton wholly internal, exhibits a conformation, in which the trunk of the body is enclosed on every side by a bony case, which leaves openings only for the head, the tail, and the fore and hinder extremities. Although this structure bears some resemblance to that of the echinus and the crustacea, yet the substance which forms the outward defence is a real osseous structure, developed in the same manner as other bones, subject to all the changes, and having all the properties of these structures. Security seems to have been the object of the Author of Nature in this mode of formation, and for its attainment a vaulted and impenetrable roof has been constructed, capable of resisting enormous pressures from without, and proof against any ordinary measures of assault.

It is curious to remark, that, in the accomplishment of this design, nature has been true to the type of vertebrated animals, even while that design rendered a new arrangement and an apparent anomaly necessary. On examination, we find that all the bones composing the skeleton in other vertebrated animals exist also in the tortoise; and that the bony case which envelopes all the other parts, is really formed by an extension of the spinous processes of the vertebræ and ribs on the one side, and of the usual pieces which compose the sternum on the other. 'It is scarcely possible,' says Dr. Roget, 'to have stronger proofs, if such were wanting, of the unity of plan which has regulated the formation of all animal structures, than those afforded by the skeleton of the tortoise.'*

The tortoise class has been divided into four great families one inhabiting salt water, two others fresh water, and a fourth living entirely upon the land. In all of them the same at-

* Bridgewater Treatise, vol. i. p. 465.

tention is manifested, that of protecting an inert animal from he attacks of its numerous foes.

This order, like that of the saurians, afterwards mentioned, is of very ancient date, and is to be found connected with the secondary series of geological formation, and existing along with the saurians, in every successive period of deposit down to the present day. The habits and functions of these early animals appear to have been similar to those of the existing species; and they are found in localities which prove, that, like them, different kinds lived respectively in the sea, in rivers, and on dry land. In general, these fossil species have been of larger dimensions than those which exist at present; and Cuvier mentions a sea-turtle, found at Luneville, the shell of which was eight feet long.* The impressions of footsteps made on the sand-stone of Corncockle Muir, which Dr. Buckland has discovered to be those of the land-tortoise, are a proof of the existence of a species at that period, exceeding in size that of the corresponding species of the present day.†

* Oss. Foss. vol. v. part 2. p. 525.

† In the observations on geology contained in the 'Winter' volume, I quoted some observations of Dr. Buckland on the footmarks of the land-tortoise in the quarry of Corncockle Muir. I may take this opportunity of adding, that the footmarks are not entirely confined to that locality, having been found in various other quarries in that neighbourhood, and in the quarry of Craigs, in the immediate neighbourhood of Dumfries. In regard to the latter fact, the following notices may interest the geologist:—The Craigs Quarry, where these additional footmarks occur, is situated about two miles to the east of Dumfries, and is at the distance of between nine and ten miles south from the quarry of Corncockle Muir, from which it is separated by a chain of hills of transition rock, running from east to west, and dividing the basin of the Annan from the valley of the Nith. The sandstone on which the footmarks are found dips, like almost all the sandstone in the neighbourhood, and especially like that of Corncockle Muir, in a westerly, or rather a south-westerly direction. A foot-track is now said to be in the quarry, but hid by rubbish, lying between sixty or seventy feet below the surface of the rock. The difference between the locality in which the present footmarks are situated, and those of Corncockle Muir, may be thus shortly stated. In the latter, the quarry is situated at the top of a moderately elevated round-backed hill; in the former, it lies at the bottom of a ridge of the height of several hundred feet. In both,

There are some differences between the sea and land-tortoises, distinctly marking intelligence in suiting each to its own destined locality, which I do not stop to particularize. With respect to their mode of living, Goldsmith thus discriminates them;—'The land-tortoise lives in holes dug in the mountains, or near marshy lakes; the sea-turtle in cavities of rocks, and extensive pastures at the bottom of the sea. The tortoise makes use of its feet to walk with and burrow in the ground; the turtle chiefly uses its feet in swimming, or creeping at the bottom.'

The tortoise is a harmless animal, if left undisturbed. Secure in the pent-house of its shell, it can bid defiance to the attacks of other animals; and, living wholly on vegetable food, it has no predaceous habits to render it ferocious. It, therefore, never seeks the encounter; but its repose cannot be invaded with impunity. It is furnished with such a strength of jaw, that, though its mouth be destitute of teeth, and armed only with bony plates, wherever it fastens it infallibly keeps its hold, until it has taken out the piece. Even when the head is cut off, the jaws do not relax; and the muscles in death preserve a tenacious rigidity.

The following account is given by Goldsmith of the astonishing vitality of this singular animal:—'Nothing can kill it; the depriving it of one of its members is but a slight injury; it will live though deprived of the brain; it will live though deprived of its head! Redi informs us, that, in making some experiments on vital motion, he, in the beginning of the month

the impressions occur in *flagstone*, incumbent on which lie thick seams of solid rock; but in the Craigs Quarry there is this remarkable peculiarity, that while all the rest of the sandstone dips in the direction already mentioned, about an angle of 45 degress, there is a stratum, or rather, I believe, a series of strata, of from fifteen to twenty feet in thickness, much coarser, and more friable, which is superinduced over the whole, lying nearly horizontal, and whose seams have no relation to those beneath, indicating a later and entirely independent deposit. What strata lie immediately above these horizontal layers I do not know, but towards the top of the ridge there are extensive rocks, if not continuous strata, of coarse sandstone conglomerate.

of November, took a land-tortoise, made a large opening in its skull, and drew out all the brain, washed the cavity, so as not to leave the smallest part remaining, and then, leaving the hole open, set the animal at liberty. Notwithstanding this, the tortoise walked away without seeming to have received the smallest injury; only it shut the eyes, and never opened them afterwards. Soon after the hole in the skull was seen to close; and in three days there was a complete skin covering the wound. In this manner, the animal lived without a brain for six months, walking about unconcernedly, and using its limbs as before. But the Italian philosopher, not satisfied with this experiment, carried it still further; for he cut off the head, and the tortoise lived for twenty-three days after its separation from the body. The head also continued to rattle the jaws, like a pair of castanets, for above a quarter of an hour.'

The vital energy of these creatures is not less remarkably displayed in their longevity, than in their surviving injuries, which would destroy any other vertebrated animal. Tortoises are well known to live more that eighty years; and Mr. Murray, in his 'Experimental Researches,' records the following instances of protracted life:—In the Library of Lambeth Palace is the shell of a land-tortoise, which was brought there alive about the year 1623, and which lived to 1730, a period of 107 years. Another was placed in the Episcopal Garden of Fulham by Bishop Laud in 1625, which died in 1753, having survived 125 years. Another is mentioned as having lived 220 years; and one in Exeter Change 800 years! The latter account, however, is very problematical.

It is worthy of remark, that not only this species of inferior vertebrated animals, but those to be subsequently noticed, namely, serpents, and the saurian reptiles, have a peculiar and analogous arrangement as to the circulation of their blood. Their blood does not, as anatomists express it, go through the great circulation. The creature has lungs, but the blood, instead of passing through them, as is the case with most warm-blooded animals, goes directly to the arteries, which send it

through the frame. Hence it is able to live a considerable time without the necessity of breathing, though it would at last be stifled if put into a close vessel.

We have often, in the course of our investigations, had occasion to admire the varieties in the orders of organized existences, and the adaptations to peculiarities of habits and of locality, which they exhibit. Need I remind the reader of the new instances which the various reptile races exhibit of the same remarkable qualities? or is it necessary for me to draw the inferences as to the Divine perfections, and the inexhaustible resources of Creative skill which they display?

SEVENTH WEEK—SATURDAY.

REPTILES.—THE SERPENT.

THE most simple of all the vertebrated animals, in its bodily organization, is the serpent, for which reason it is usually placed lowest in the scale of land animals belonging to this order.

'The serpent,' says Goldsmith, 'has from the beginning been the enemy of man, and it has hitherto continued to terrify and annoy him, notwithstanding all the arts that have been practiced to destroy it; formidable in itself, it deters the invader from the pursuit; and from its figure, capable of finding shelter in a little space, it is not easily discovered by those who would venture to try the encounter. Thus, possessed at once of potent arms, and inaccessible or secure retreats, it baffles all the arts of man, though never so earnestly bent on its destruction.'* It is probably owing to these gifts of its Creator, that even in the most civilized and best peopled countries, this poisonous and detested brood is still to be found spreading over the forests, and infesting the woodland path throughout almost every temperate and tropical region of the world.

The relative size of the serpent tribes is more various than

* Animated Nature, vol. iv. book iii. chap. i.

that of any other class of animals, extending from a few inches in length to forty or even fifty feet. Probably the most formidable species has fallen and become extinct beneath the prowess of man, for early tradition abounds in details of the feats of heroes against serpents, which infested large districts with their fætor, and devastated whole provinces. There is, doubtless, exaggeration in these accounts, but this cannot be said of the historical fact, that while Regulus led his army along the banks of the river Bagrada, in Africa, an enormous serpent disputed his passage across. We are assured by Pliny, who says that he himself saw the skin, that it was a hundred and twenty feet long. It had destroyed many of the army, till at last the battering engines were brought out against it; and these assailing it at a distance, effected its destruction. Its spoils were carried to Rome, and lodged in the Capitol, and the general was decreed an ovation for the deed. In the present day, the Great Liboya of Surinam, which is said to be the largest species in existence, seldom exceeds thirty-six feet. Legaut, however, says he saw one in Java that was fifty feet long.

The skeleton of the serpent class exhibits the greatest possible state of simplicity to which a vertebrated animal can be reduced; for it consists merely of a lengthened spinal column, with a head but little developed, and a series of ribs. The vertebræ are very numerous, and are all united by ball-and-socket joints, which give peculiar flexibility to the animal; and there are other admirable provisions, noticed by naturalists, in the ribs, and in the direction of the processes, to ensure that flexibility, and to admit of the body assuming every degree and variety of curvature.*

The marks by which this species is distinguished from the rest of the animated creation, are thus given by the author from whom I have previously quoted:—'They have the length and the suppleness of the eel, but want fins to swim with; they have the scaly covering and pointed tail of the lizard, but they want legs to walk with; they have the crawling motion

* Roget's Bridgewater Treatise, vol. i. p. 45.

of the worm, but, unlike that animal, they have lungs to breathe with.' Their most formidable weapon of offence is their poisonous teeth, which are thus described by Dr. Roget. 'The fangs of serpents are furnished, like the stings of nettles, with receptacles at their base for a poisonous liquor, which is squeezed out by the pressure of the tooth, at the moment it inflicts the wound, and conducted along a canal, opening near the extremity of the tooth. Each fang is lodged in a strong bony socket, and is, by the intervention of a connecting bone, pressed forward whenever the jaw is opened sufficiently wide, and the fang is thus made to assume an erect position.'—'The tube through which the poison flows is formed by the folding in of the edges of a deep longitudinal groove, extending along the greater part of the tooth, an interval being left between these edges, both at the base and extremity of the fang, by which means there remain apertures at both ends for the passage of the fluid poison.'*

This animal, although placed at the bottom of the scale of vertebrated existences, on account of the simplicity of its organization, is yet too artificially constructed to render it possible for the most careless observer to overlook the proofs which it affords of exquisite skill in the Creator. The intention of the Divine Mind in calling an animal into existence, at once so formidable and so malignant, for it is fierce and irritable, is a very different and more recondite question. Goldsmith says of serpents, that 'nature seems to have placed them as sentinels, to deter mankind from spreading too widely, and from seeking new abodes, till they have cultivated those at home.' Paley takes a more extended view of the subject, and after confessing the difficulty which surrounds it, reasons as follows:—'From the confessed and felt imperfection of our knowledge, we ought to presume, that there may be consequences of this economy which are hidden from us. From the benevolence which pervades the general designs of nature, we ought also to presume, that these consequences, if they could enter into our calculation, would turn the balance on the favourable side. Both

* Roget's Bridgewater Treatise, vol. ii. pp. 163, 164.

these I contend to be reasonable presumptions:—not reasonable presumptions, if these two cases were the only cases which nature presented to our observation;—but reasonable presumptions under the reflection, that the cases in question are combined with a multitude of intentions all proceeding from the same Author, and all, except these,* directed to ends of undisputed utility.' Paley adds some considerations, which, if they do not entirely vindicate the economy of Providence, at least greatly abate the difficulty attached to it. These are briefly, 1*st*, That the animal itself being regarded, the provision is *good*. It is a formidable means of defence from its enemies, and sometimes of subduing its prey. 2*d*, The poisonous bite is seldom fatal. 3*d*, While only a few species possess the venomous property, that property guards the whole tribe. There are only thirty-two tribes poisonous out of two hundred and eighteen described by Linnæus. 4*th*, The nature of serpents, as that of other existences, is appropriated to peculiar situations, which are, as it were, their own; and when man or other animals encroach on these, they do it at their peril.'†

There is, doubtless, much in this reasoning; but it does not touch the main difficulty, which indeed Revelation alone can remove. I allude not merely to the existence of evil; but, in the present instance, to the elaborate preparation of instruments for the infliction of it, apparently beyond the necessity of the case. We can understand how this may be in a fallen world; and it is exceedingly remarkable that the only contrivance which cannot entirely be vindicated, as on the whole benevolent, that, I mean, whereby venom is infused into the bite, should be discovered to exist among a class of reptiles to which revelation points as being the medium through which sin entered into the world, and all our woe. We may well believe, that when the curse fell on the serpent, by which it was made to 'creep on its belly,' it was at the same time invested with its

* With the question of venomous bites, Paley combines that of animals preying upon each another. These, therefore, are also included in his exception.

† Natural Theol. vol. ii. chap. 26.

poisonous fangs, as a memorial of the awful transaction to which it became accessory, and an instrument of that malignity, which was rendered thenceforth inherent in its nature.

EIGHTH WEEK—SUNDAY.

'THE OLD SERPENT.'

THE serpent, whose peculiarities of structure and habit we yesterday considered, was employed soon after the creation of man, as an instrument in that awful transaction, by which 'sin entered into the world, and death by sin.'

From the intimations given in different parts of the Sacred Volume, we discover that there are various races of intelligent beings, not merely existing in the universe, but in some way, not very clearly explained, connected with our own earth, and interested in human affairs. This is only what might have been suggested as probable by a sound philosophy, independent of revelation. Up to man we behold one unbroken chain of existence, raising from the lowest state of organic life to the highest, by links beautiful in their combinations, and wonderful in their variety and extent. But at man, this astonishing fabric seems suddenly to stop short. The whole of these links appear to end in him; or, at all events, the continuation of the chain is no longer the object of our senses. When we consider the nature of man, it seems to be incredible that *he* should be the chief work of the Eternal; that a being so imperfect, so inconsistent, and so depraved, should crown the admirable structure of creation; that life should exist in such profusion, and in such amazing diversity of forms and powers beneath him, and that the glorious plan, commenced on so magnificent a scale, should have been suddenly broken off, just as the threshold of reason had begun to be entered. There is undoubtedly an infinite space between man and his Creator, in which intelligent beings might exist; and the amazing

scheme might be carried upward in varieties which could never be exhausted, and in a progression which could never be completed. Are we to conclude, then, that this space is left altogether unoccupied? The analogy of nature forbids the supposition, while Revelation confirms the argument from analogy, and assures us that the fact is otherwise.

There is, then, a world of intelligence which is not the object of our senses. The chain is not broken off, or concentrated in man; it only vanishes from our imperfect vision. Man is the link which connects the rational with the irrational creation, but the faculties bestowed upon him do not enable him to trace the chain upward Were he but to possess a sixth sense, a scene might be opened to him, similar to that which burst upon the assisted eye of the prophet's servant, when he saw the whole mountain filled with living beings invisible to our natural sight.

The analogy of nature seems further to render probable, that there may exist, in this unseen world, much more degradation in connexion with high intellectual attainments. This, at least, is the case among men. Mental endowments, so far from insuring moral rectitude, seem frequently only to bestow greater force and malignity on evil inclinations. It appears hard to believe that this perversity should be extended to orders of superior beings, but scarcely harder than to believe that sin should exist at all in the universe of a holy God. Undoubtedly among the rational creation of mortals, sin has not only gained admittance, but a triumph; and it is merely following up this analogy to conceive that the same perversity may be found in higher races. Now, the Divine Record also confirms *this* analogy. It assures us that moral evil exists in the spiritual world, and that a rebel empire of wickedness is permitted by the Creator, for his own wise but inscrutable purposes, to be organized under a prince of stupendous power, and insatiable malignity. The dominion of this tremendous being has been extended over man, and his agency is disastrously connected with the history of our species.

The creation of our first parents in the full perfection of their

moral and intellectual powers, and the awful transaction by which a fatal revolution took place in the character and history of the human race, are recorded in the commencement of the Sacred Volume, and are too familiar to every mind, to require a particular description. Indeed, the extreme conciseness of the Revealed Word, with regard to this, as well as to other matters which strongly excite human curiosity, but are not necessary for spiritual edification, prevents the possibility of entering into minute details, without the danger of 'darkening counsel by words without knowledge.' It is, however, revealed, that when the Creator made to man the grant of vegetable food, he reserved from that grant one fruit-tree, which was to constitute a standing memorial of man's dependance, and of the Divine bounty; thus calculated to cherish in his heart a salutary sentiment of humility when he regarded himself, and of gratitude when he looked up to the Beneficent Giver. This reservation was also intended to serve as a test of submission and obedience. It was, in fact, man's only trial. His moral and intellectual faculties were so nicely adjusted, and his desires were so fully gratified, that he had no temptation to harbour one uneasy or undutiful thought. He had not a wish beyond the paradise in which he lived. But here one restraint was laid upon his liberty. There was only one; but on that very account, it might be felt to be more galling in the first movements of a restless and impatient spirit. What could this prohibition mean? The fruit of the tree was 'pleasant to the eyes;' it seemed to be delicious; it was surely wholesome, for it was formed by Him who made all things very good; certainly in was not created in vain; why should this form the only exception to the grant of food? There was something contrary to the usual dealings of a Paternal Governor in such an exception. Was it not needless? Was it not capricious? Could it really be intended?

Such might possibly be the progress of the temptation infused into the mind of our first mother by the tempter; and as Eve permitted the poison to work, he found her, when he assumed a visible form, prepared for his malicious purposes.

The interview it is unnecessary particularly to describe. It was the spirit of evil, full of subtlety, contending with unsuspecting innocence, in an unguarded hour. The contest was short and decisive. Man fell, and the power of darkness triumphed.

There are some most mysterious circumstances attending this transaction. With reference to the Divine government, indeed, it concentrates in itself *all* mystery. Within the range of the human faculties, there is nothing embarrassing and incomprehensible in the administration of the Eternal, which may not be referred to the existence of moral evil, first manifested to the human race in this transaction. It had previously been introduced among a higher order of beings; it was henceforth to shed a blight on the history of man. We believe its truth; we see its unhappy consequences; we know also the remedy provided: we perceive an amazing scheme connected with it, full of ineffable grace, and overflowing love; but yet clouds and darkness brood around it.

'Lo, this only have I found,' says Solomon, 'that God hath made man upright, but they have sought out many inventions.' It was, doubtless, the abuse of free will implied in these words, which lay at the bottom of Adam's transgression. He was made free, and therefore liable to fall. Freedom of will is a property inherent in reason, and forming, indeed, part of its very essence. Deprive man of freedom of will in the exercise of his rational powers, and you deprive him of reason itself. You render him a mere machine, governed by external impulses. Man possessed this noble but dangerous gift. He abused it, and was ruined.

In turning to the subordinate circumstances of this transaction, one of the most remarkable appears to be, the assumption, by the arch-tempter, of the form of a serpent. Our utter ignorance of many peculiarities in the state of existence during those ages of innocence, renders it impossible to understand why this disguise should be the best adapted for gaining his end. That it was so, however, is intimated, when it is said, that 'the serpent was more subtle than any beast of the field,

which the Lord God had made;' and that he was afterwards degraded from his original condition, both in form and in faculties, appears more than probable from the tenor of the curse pronounced on this instrument of the Evil One:—'Because thou hast done this, thou art cursed above all cattle, and above every beast of the field; upon thy belly shalt thou go, and dust shalt thou eat all the days of thy life.'

But however this may be, it is at least certain, that the condition of the serpent has been, ever since the fall of man, what is described in these words; and the last and most emphatic part of the curse has also been fulfilled to the letter:—'I will put enmity between thee and the woman, and between thy seed and her seed; it shalt bruise thy head, and thou shalt bruise his heel.'

That these latter words, however, contain a deeper meaning than the literal phrase imports, has been constantly and universally understood by the interpreters of Divine Revelation. They contain, in fact, a prophecy of that glorious event predetermined in the counsels of the Eternal, by which the calamity of the fall was to be repaired, and that which was intended to mar the work of the Creator, was to afford a new occasion of causing his perfections to shine forth with additional splendour and loveliness. In a sense unspeakably superior to the literal, 'the seed of the woman' has bruised the 'head of the serpent.'

EIGHTH WEEK—MONDAY.

REPTILES.—THE SAURIAN TRIBES.

If we are to believe geologists, there was a period in the history of the earth, when saurians, or animals of a similar type with the crocodile and lizard of the present day, held supreme sway over sea and land. This was the period of the secondary formation, when the ground is supposed to have been little elevated above the surface of the waters, and when

almost interminable swamps and shallows required a peculiar form of animals, with functions, instincts, and habits accommodated to this state of the terraqueous globe.

'The peculiar feature in the population of the whole series of secondary strata,' observes Dr. Buckland, 'was the prevalence of numerous and gigantic forms of saurian reptiles. Many of these were exclusively marine, others amphibious, others were terrestrial, ranging in savannahs and jungles, clothed with a tropical vegetation, or basking on the margin of estuaries, lakes, and rivers. Even the air was tenanted with flying lizards, under the dragon form of pterodactyles.'*

Those who take an interest in geological studies, will agree with this author, when, in another part of his work, he says that, in reflecting on the large and important range assigned to reptiles, among the former population of our planet, many thousand years before the creation of its present inhabitants, 'we cannot but regard with feelings of new and unusual interest, the comparatively diminutive existing orders of that most ancient family of quadrupeds, with the very name of which we usually associate a sentiment of disgust.'

Of the order of saurians, which formed so distinguished a part of a former creation, the species which seems to approach nearest the type of this order of animals, as they existed in that early period, is the gavial, or East India alligator. This formidable creature inhabits the borders of the Ganges. It differs from the crocodiles of Egypt, by having the jaws much narrower, and much more lengthened, so as to appear, in reference to the size of the head, like a beak. The teeth also are smaller and more numerous. Like the rest of its genus, it sometimes attains a very large size, compared with the other inhabitants of our present earth, extending to thirty feet; though the most enormous of them all would form a mere pigmy in the presence of some of the ancient race of the secondary formation.

The saurian reptiles, as they at present exist, may be popularly divided into crocodiles and lizards, each of which had

* Geology, Bridgewater Treatise, vol. i. p. 74.

i s prototype in the monsters of the geological period to which we have alluded. The various tribes of this order differ much in form and habits. Some are extremely slow in their movements, while others change their place with great agility. Some frequent the waters, and always remain in their neighbourhood, while others, such as the common lizard, are found basking in the sun on barren heaths. The crocodile tribe shall at present be selected as a specimen of this order.

Nature, says Lacépède, has granted to the eagle the higher regions of the atmosphere; has given to the lion for his domain the boundless deserts of the hot climates of the world; and has abandoned to the crocodile the shores of the sea, and of the mighty rivers of the torrid zone. These immense animals, living equally upon the inhabitants of the sea, and on those which the earth nourishes, exceed in size every other creature of their own order. They divide their prey, neither with the eagle, as the vulture, nor with the lion, as the tiger, but exercise a domination greater than either. They are less easily extirpated, as their property of frequenting both land and water enables them more readily to avoid the snares of their enemies. The low temperature of their blood, too, which endues them with the power of sustaining hunger for a considerable time, places them less frequently under the necessity of braving danger for the sake of satisfying their appetite.

Naturalists have added to the gavial of India, and the crocodile of Egypt, already mentioned, another distinct species, or rather family, that of the alligator of America. In all these three regions of the world, where extensive swamps and lagoons exist under a burning sun, or broad rivers flow slowly, through low and reedy banks, these monstrous animals dispute possession with man, their only formidable enemy.

'In Louisiana,' says an American author, speaking of the alligator, 'all our lagoons, bayous, creeks, ponds, lakes, and rivers, are well stocked with them; they are found wherever here is a sufficient quantity of water to hide them, or to furnish them with food; and they continue thus, in great numbers, as high as the mouth of the Arkansas River, extending

east to North Carolina, and as far west as I have penetrated. On the Red River, before it was navigated by steam-vessels, they were so extremely abundant, that to see hundreds at a time along the shores, or on the immense rafts of floating or stranded timber, was quite a common occurrence, the smaller on the backs of the larger, groaning and uttering their bellowing noise, like thousands of irritated bulls about to meet in fight; but all so careless of man, that, unless shot at, or positively disturbed, they remained motionless, suffering boats or canoes to pass within a few yards of them without noticing them in the least. The shores are yet trampled by them in such a manner, that their large tracks are seen as plentiful as those of sheep in a fold.'

The insensibility to the presence of man evinced by the alligator on the banks of the Red River, is only one instance of a fact well known to travellers, that, in unfrequented parts of the earth, that dread of the human race, which seems instinctive to the lower animals where they mingle with man, is almost unknown. Cowper beautifully alludes to this remarkable circumstance in the soliloquy he puts into the mouth of Robinson Crusoe :—

'I am out of humanity's reach;
I must finish my journey alone;
Never hear the sweet music of speech;—
I start at the sound of my own!
The beasts that roam over the plain,
My form with indifference see;
They are so unacquainted with man,
Their tameness is shocking to me.'

The common crocodile is the species well known as frequenting the rivers of Africa. In the central parts of that continent, they are said to attain the enormous size of the gavial of India. On the banks of the Nile, however, their dimensions are smaller, it being a striking fact, that where man has taken up his abode, all the animals hostile to his prosperity dwindle in size, and become diminished in ferocity, owing probably to their circumscribed bounds, and the privations to

which they are subjected by the tremendous force and influence of human reason. These animals are capable of being tamed. Bruce mentions, that in Abyssinia, children may be seen riding on their backs; and it is a well known historical fact, that the priests in the temple of Memphis in Egypt, in the celebration of their heathen mysteries, were in the habit of introducing tame crocodiles to the deluded multitude as objects of worship. They were fed from the hands of their conductors, and decorated with jewels and wreaths of flowers.

If we inquire into the office assigned to these horrid creatures in the economy of the Author of Nature, we shall find it sufficiently evident, that they belong to the class intended as checks on over-production; and that the existence of some such devourer of animal life in the prolific regions which they haunt, is, upon the whole, a blessing, it is not difficult to conceive. The alternative of animals increasing in numbers, till they die of starvation as they are produced, is too distressing to be reflected on without shuddering; and yet, unless there were a system of checks, such as we find to exist in carnivorous animals, this would be the necessary result. One of the ways in which this check practically operates in the case of the alligator, may be understood by attending to the following graphic description of its operations during the dry season, given by the traveller from whom I have already quoted:—'Each lake has a spot deeper than the rest, rendered so by those animals, who work at it, and always situated at the lower end of the lake, thereby insuring themselves water as long as any will remain. This is called by the hunters the alligators' hole. You see them there lying close together. The fish, that are already dying by thousands, through the insufferable heat and stench of the water and the wounds of the different winged enemies constantly in pursuit of them, resort to the alligators' hole to receive refreshment, with a hope of finding security also, and follow down the little currents flowing through the connecting sluices. But no! for as the water recedes in the lake, they are here confined. The alligators thrash them, and devour them whenever they

are hungry; while the ibis destroys all that make towards the shore.'

There is a strange mixture of wisdom and folly in the human character; and the latter quality can scarcely be exhibited in stronger operation, than when it erects the crocodile or the serpent into an object of religious worship, and causes intelligent man to bow the knee before the lowest and most malignant orders of the brutes. It exemplifies, however, this important truth, that terror takes a prominent place in the devotions of unenlightened men, and is, indeed, the groundwork of all superstitious belief. It is not till the human mind is emancipated and enlarged by revelation, that this emotion is changed into the ennobling feeling of veneration, or gives place to the still more exalted and generous sentiments of love, gratitude, and pious confidence. I can make no exception in favour of the deist of the present day, both because his religious feelings, when they exist at all, are very often unconsciously modified and enlightened by a Christian education; and because, when that is not the case, they consist either in cold abstractions, or in a feeling of mere sentimentality.

EIGHTH WEEK—TUESDAY.

BIRDS.—THEIR RELATIVE POSITION.—THE BILL.

As we advance in the scale of being, new wonders strike our view, which furnish us with additional illustrations of the Divine perfections. From reptiles, the transition to birds is a great and sudden step; and we are introduced at once into a new system, in which the contrasts are not less numerous and remarkable than the analogies; but in which the intention of all the differences is obvious, and the adaptation to new functions and conditions is beautiful and complete.

When we examine the structure of birds, we find that it is more complicated than that of the animals we have already been contemplating, though inferior in this respect to the

quadruped races. If we consider the mental powers with which they are endowed, it will appear that these also are intermediate between the same classes; but, if we regard the functions they are destined to perform, we shall discover in that which is their distinctive property, a superiority not merely over the order of quadrupeds, but over man himself.

The power of moving through the air is a very remarkable endowment, which, though it be shared with insects, may be considered, among vertebrated animals, as the peculiar property of birds. It is true, indeed, that there is scarcely any power, however peculiar, belonging to a great order of organized beings, to which we do not find approaches in species of another order; and this holds true of the power of flying. If we turn to the finny tribes, we find this quality partially possessed by the flying fish; if we regard reptiles, the same thing may be said of the flying lizard; if we look upward in the scale, we discover among quadrupeds also a connecting link in the bat and the vampire. These, however, are exceptions to the general rule in their respective classes, and merely serve to follow out that remarkable law of nature, by which all orders, classes, and species, seem to run into each other, so as to exhaust almost all the possible forms and functions of organized existences, and to fulfil the beneficent intention of peopling creation with interminable varieties, up to the extent of its varied resources.

As another instance of the approximation of two distinct and even distant orders to each other, I may mention that of the humming-bird to the insect tribe. These interesting little creatures, while, like the bee, they emit that peculiar sound, in flying, from which they take their name, flutter from flower to flower, and suck nectar like the butterfly, for which, on a casual glance, they might easily be mistaken. Their tiny bill is a rival to the proboscis of the insects I have mentioned.

In a former part of this work, I adverted at some length to the contrivances whereby birds have been fitted to the element through which they were designed to find their way;*

* 'Spring.'—Relation of the Bodies of Birds to External Nature.

but there is much relating to the peculiarities of this order of beings which has been left unsaid. In the remainder of this paper, I shall confine myself to a single member, with regard to which a few particulars shall be mentioned, which exhibit striking adaptations.

The bill of a bird is very peculiar in its conformation, and has obviously been formed with reference to the structure and functions of the animal in other respects. It was intended to cleave the air in flying, and therefore it was of importance that it should be sharp and pointed, and should project from a small head; and it was designed to act as an instrument of defence, and as a hand by which to seize its food, and in birds of prey, to tear it. Had a mechanic been called upon to construct a mouth for such an animal, he would certainly, with all his ingenuity, have failed to invent so perfect an instrument as a bill.

But it is not merely in the general type, it is also in the variations for particular purposes, that the skill of the Creator is exhibited. Take the bill of the domestic fowl as the general basis of the contrivance, and we have an instrument simply but admirably fitted to act at once as a mouth and a hand, having nothing to do but to pick up food, to arrange its nest, and to plume its feathers, or to defend itself when attacked. If we compare it with the bills of other species of the tribe called *Passeres*, to which the domestic fowl belongs, we shall find numerous variations even in this simplest form. The blackcock, the pheasant, the bullfinch, and the lark, may be mentioned as examples. But take other orders, and the variation becomes still more marked. There are tribes which feed on worms and larvæ residing deep in the earth, and requiring to be reached by an elongated instrument. Such an instrument has been bestowed on them. The lengthened bills of the curlew, the woodcock, and the plover, are of this description. The mechanical contrivance is here simple and obvious. But more skill was required to form a forceps of horn capable of distinguishing a soft worm among the equally soft mud in which it was embedded: In the wood-

cock, and feeders of this kind, the end of the bill is not horny, but is provided with nerves, so that it becomes a finger to feel, as well as a hand to hold, and a mouth to eat. 'It is doubtful,' says Dr. Macculloch, 'if the most delicate human finger could feel the food of a woodcock where it lies. But there is even more of contrivance, if I mistake not, in this provision. The nerves are large beyond all apparent necessity; utterly disproportioned to a nerve of touch in any other animal body. It was necessary that the point of the bill should be tough and firm; and the magnitude of the nerves forms a compensation for this.'*

The duck, and other flat-billed birds, form another variety, whose instruments are intended for a purpose somewhat similar. They have to obtain their food in mud below the water. Here the teeth form a strainer, like the same engine in the whale, while a highly sensitive bill and tongue aid each other in separating what is wanted, and rejecting what is superfluous.

The birds of prey exhibit a conformation adapted to their purpose, not less effectual than it is simple. It consists in giving to the upper mandible a crooked form, which affords the animal much power in holding and tearing the flesh off its prey. It would be easy to follow out this enumeration, by other cases of remarkable adaptation, such as that of the swallow and the night-hawk, which feed on insects while on the wing, and have therefore a wide mouth into which their prey may be said to fly; the cross-bill, whose instrument is so admirably adapted for opening the cones of the fir; and the spoonbill, which is literally furnished with a pair of tongs, for catching frogs. But the alterations to effect special ends are as various as the ends themselves; and enough has been said to show, that inventive wisdom has been at work not merely

* Macculloch's 'Attributes of God,' an excellent posthumous work, just published (1837), to which the reader will find, that I am much indebted in the remaining part of this volume. I feel great pleasure in announcing this new coadjutor, in a department of study at once so delightful and so edifying.

in contriving the instrument, as regards its general type but also in effecting those deviations which are so remarkably suited to the peculiar wants and habits of each particular class and species.

Were we to pass from the bills to the eyes of the winged tribes, we should not find less reason for admiration. The largeness of the organ, in comparison with the size of the animal, its horny structure, and nictating membrane to protect it from injury, the amazing keenness of sight in birds of prey, and a variety of other particulars, proving studious adaptation to circumstances, might be mentioned; but the vision of birds is a subject worthy of distinct consideration.

Meanwhile, I conclude this paper by remarking, that the instances I have selected are connected with a system which extends to the whole animated creation, and forms a most interesting department in comparative anatomy. Take, for example, the mouth of animals, and follow this organ through all its varieties among insects, reptiles, quadrupeds, and fishes, as well as among birds; examine the variations in structure under each type, in reference to the order, the family, and the species, and proofs of most curious and skilful adaptation will break in upon you in whatever way you direct your attention, which cannot fail at once to delight the mind and elevate the devotional feelings.

EIGHTH WEEK—WEDNESDAY.

BIRDS.—THEIR POWER OF FLYING.

In a chapter on the modes of motion in animals, Dr. Macculloch makes some very ingenious and striking remarks on the relative means of progression belonging to different orders; and he shows, by an analysis of these, how admirably such means are adapted to the nature and the functions of the animal on which they have been bestowed. The following

are his observations with relation to the winged tribes, which I have somewhat abridged:—

'In turning to the mode of motion through flying, I shall scarcely be contradicted in saying, that if a mechanician had known no animals but quadrupeds, he would not have believed that a creature of great weight could have been constructed to fly through the air, and to rest on it, with as much security, as those walk and rest on the ground; and still less would he have suggested the means. A philosopher, at least, accustomed to abstraction, will admit this; whatever difficulty may be found by those who believe their familiar knowledge to be necessary and innate, forgetting how it was acquired. Yet this problem is effected, widely, in respect to the velocities and the varieties of this mode of motion, and in a very remarkable manner, as regards the weights thus sustained and moved; so unimportant are difficulties, under the resources of the Creator.

'The general construction for this purpose, under what is a mere variation from the form of the quadruped, is already understood, in the conversion of the fore extremities into wings; the enlargement of the breast bone, with its powerful muscles; the extent of the lungs; the hollowness of the bones; and the levity, compact arrangement, and length of the feathers, to which I must add the form of the body, and the smoothness of the surface, the first constituting one of those figures, which, as in fishes, mathematicians are pleased to term solids of least resistance, though far from having yet mastered that difficult branch of analysis, in either case.

'The form, position, and action of the wings constitute the principle of motion, the two first differing little in the several kinds, otherwise than in spread or length, but the latter varying considerably. The motions used in flying are familiar; but it is not so obvious how progression is the consequence of what appears to be a series of vertical alternate impulses on the air. A mathematician should find no difficulty, through his doctrine of the resolution of forces; but they who are not familiar with this science, yet who know that a ship

can advance under many obliquities of the wind on its sails, and who will recollect that the motion of the wing is equivalent to that of the breeze, will form a sufficient conception of the subject, from the following facts, which they may not have analyzed. The impulses are not vertical, but obliquely curved, backwards and forwards, from that line to the horizontal; while the convexity of the wings, with the comparatively feeble action of the corresponding muscles, diminishes the resistance forwards; as their concavity, with the rapid and powerful action downwards and backwards, and especially in the latter direction, gives the impulses for motion. In the different positions of the wing also, it is a sail, acted on by a more or less favourable oblique wind; going "large" when in its most favourable position, and "near the wind" when in the least; while, as in the ship, the progressive impulses are aided by the form of the bird, and, while those inevitable ones in a vertical direction, which follow from the necessary construction, are checked by the lateral resistance and further balanced against each other, so that there is no lee-way. That lee-way, it is plain, would be upwards; and it can be produced, for the purpose of ascending, by modifying the action of the wings, as is done by the lark. All else is simple; and, if the bird advances against the wind, it is merely because the motion of the wing is the more rapid of the two; it is a stronger opposed breeze. The tail, as all know, is used for balancing; yet it occasionally assists in the steerage; this also is the proper office of the wings.

'There are not many variations in this motion, requiring notice for the present purpose: but such as they are, there is an object and use in them all, and slight differences in action and form accomplish everything. In the sea-birds which neither dive nor swim, long flights and great duration were necessary, because their food is often rare, and wide apart, and far also from their homes. Hence the great and untiring powers of the gull and the gannet, and of the albatros above all, the velocity of which is said to amount to 100 miles in an hour. If greater muscular powers have been conferred in

these cases, so has a larger wing; while this is one of those unnoticed contrivances for saving exertion, the wisdom of which is apparent as soon as it is stated. The short-winged sparrow must close its wing to the sides, as must the partridge, frequently and with great force, that it may gain sufficient velocity; whence the noisy flight of those birds, while they are also unable to maintain it very long. The sea-fowls in question need not labour so hard: the size of their sails is a compensation for that slighter exertion, under which they are always "nearer the wind." In the far-migratory birds, the arrangements are similar; there is great muscular power, or great spread of wing, or both. If the short-winged small birds sometimes migrate, it is to short distances, as we know that they are also often drowned at sea; but the general rule will be found to hold, as is familiar in the wag-tail, the lark (requiring long wings, however, chiefly for the sake of its peculiar flight), and others.

'If the swallow demanded long wings and great power, for the same reason as the sea-birds, still more were these necessary for the pursuit of its agile and scarcely perceptible prey; not attainable, had it not possessed the power of suddenly changing the line of its flight; and to this is added the highest known velocity in birds, since the motion of the swift has been computed at seventy feet in a second. In many other birds, where similar angularity and rapidity of movements were required, for the same or analogous purposes, there are appropriate arrangements, in the actions or in the wings themselves; while all those, especially, which pursue a small and active prey, display that universal agility of movement, which confers so pleasing a character of liveliness on this most cheerful part of the creation. The wag-tail, pursuing on the ground what the swallow does in the air, seems incapable of keeping itself at rest;—ever in motion, because it is not so easy to begin to move from a state of inaction; and thence, probably, the length of its apparent superfluity of tail. In the falcon tribe, I need not repeat what I said of the sea-birds but that peculiarity of motion necessary for watching

the movement of their prey on the ground, is in them a distinguishing feature. Nor is the power of hovering so mysterious as it often appears. The bird, in this case, is a light parachute, of considerable extent, only requiring that its balance be preserved, by a slight exertion of the tail and the point of a wing, easily moved, or restored to its place by a very slight impulse, and opposing no surface to the wind, which the bird cannot easily counteract. In the fluttering repose, the wings are caused to act vertically alone; and thus a fixed position is easily maintained. In the humming-bird, there is the same power, for a well known purpose.'*

EIGHTH—WEEK—THURSDAY.

BIRDS.—THEIR POWER OF VISION.

The vision of birds is not less remarkably adapted to their situation and necessities, than their faculty of moving through

* 'Attributes of God,' vol. ii. pp. 100–105.

With regard to the power and velocity of flight in different birds, M. Virey observes:—The smallest bird can fly several leagues an hour; the hawk goes commonly at the rate of a league in four minutes, or above forty miles an hour. A falcon of Henry II. was flown from Fontainbleau, and found, by its ring, at Malta next day. One, sent from the Canaries to Andalusia, returned to Teneriffe in sixteen hours, a distance of near seven hundred miles, which it must have gone at the average rate of twenty-four miles an hour. Gulls go seven hundred miles out to sea and return daily; and frigate birds have been found at twelve hundred miles from any land. Upon their migration, he states, as a known fact, that cranes go and return at the same date, without the least regard to the state of the weather, which shows, no doubt, if true, a most peculiar instinct; but these, and, indeed, all facts which we find stated by a writer so addicted to painting and colouring, must be received with a degree of suspicion, for which no one but M. Virey is to be blamed. The accounts, however, of the swiftness of the birds, I can well credit, from an experiment I made when travelling on a railway. While going at the rate of thirty miles an hour, I let fly a bee: it made its circles as usual, and surrounded us easily. Now, if there was no current of air or draught to bear it along, this indicated a rate of ninety miles an hour; and even allowing for the current, the swiftness must have

the air. In this order the formation of the eye has several peculiarities, with regard to the nature of which, in some particulars, physiologists are not altogether agreed; but it is well known, that this organ is in birds proportionally larger and more prominent than in other animals, which enables them to command a more extensive range of vision; that the substance of the eye is more hard and horny, which compensates for the danger to which its prominence subjects it; that its nictating membrane is admirably contrived, as an additional security against peril from branches of trees, or other objects, with which its habits render it liable to come in contact; that its power of altering the focus of vision, in certain tribes, is peculiar and great; and that there is yet another part of the organ, whose use has not been very clearly ascertained, but which is supposed powerfully to assist the sight called by the French academicians, the purse or comb.

Without dwelling further on the general structure of the eye in this class of animals, I shall notice some circumstances which practically show a very striking adaptation of the faculty of vision in various species to their habits and wants. And I begin by observing, that night-birds have their eye peculiarly formed for seeing in the twilight. M. de Blainville remarks, that, besides being comparatively very large, this organ is, in the class alluded to, flat, both before and behind, while the transparent cornea is placed at the end of a sort of tube. The retina is consequently large and extended, as well as the iris, while the membranes, being probably more soft and delicate, are more susceptible of impressions from a small quantity of light. The owl and the woodcock are of this description. These species, the former in particular, though by no means of acute vision by day, are remarkably quick-sighted in the evening, when they stir abroad in search of their slumbering prey.

But it is to instances of *day* vision that I intend particularly

been great. I should, however, wish to repeat this experiment before being quite sure of so great a swiftness in so small an insect.—*Quoted from Brougham's Dissertation on Science.*

to devote this paper; and the first example I shall adduce is that of the carrier-pigeon. It is believed that the remarkable faculty by which this bird finds its way to its distant home, is almost exclusively its power of sight. This opinion is supported by the manner in which it executes its journey, so far as this has been ascertained. When let off from a low station, in an unknown locality, it rises by irregular excursions to a certain height, and then commences its route by a rapid flight in gyrations, taking in a larger and larger space at every turn, and thus obtaining a complete survey of the whole district in every direction; and it is supposed to continue this circular motion till some known object arrests its vision, and makes it aware of its position, when it darts forward with incredible velocity in the right direction. If liberated from a balloon, when high in the air, the bird drops perpendicularly downwards, till it come within such a distance of the earth, that it can distinguish landmarks, and then commences its wheeling flight, as already described.

If this account be correct, the velocity of the carrier-pigeon is indeed incredible. M. Antoine relates, that a gentleman of Cologne, having business to transact at Paris, took with him two carrier-pigeons; and having arrived at the metropolis, he tied a letter to each of his pigeons, and despatched them at eleven o'clock precisely. One of them arrived at Cologne at five minutes past one o'clock, and the other nine minutes later, having thus completed a journey of 300 miles in little more than two hours! This was at the rate of nearly 150 miles an hour, supposing their flight had been in a direct line. If it was circular, as observation would lead one to suppose, the extent traversed must have been immensely greater.

Audubon gives a similar, though considerably less marvellous, account of the velocity of the American pigeon. He says, that pigeons have been killed in the neighbourhood of New York, with their crops full of rice, which they must have collected in the fields of Georgia or Carolina, these districts being the nearest in which they could have procured a supply of this kind of food. 'As their power of digestion is

so great, that they will decompose food entirely in twelve hours, they must in that case have travelled between 300 and 400 miles in six hours, which shows their speed to be, at an average, about one mile in a minute. A velocity such as this would enable one of these birds, were it so inclined, to visit the European continent in less than three days.' This naturalist goes on to observe, that the great power of vision possessed by the pigeon, enables it, as it travels at that swift rate, to inspect the country below, and discover its food with facility; which he has ascertained by observing, that when traversing barren tracks, they keep high in the air, to descry distant lands; whereas, when the country is fertile, they fly lower, to fix on the part most plentifully supplied with food. 'As soon,' he graphically adds, 'as the pigeons discover a sufficiency of food to entice them to alight, they fly around in circles, reviewing the country below. During their evolutions on such occassions, the dense mass which they form exibits a beautiful appearance as it changes its direction, now displaying a glittering sheet of azure, when the backs of the birds come simultaneously into view; and anon suddenly presenting a mass of rich deep purple. They then pass lower over the woods, and are for a moment lost among the foliage; but again emerge, and are seen gliding aloft.'*

It would appear, from an observation of Professor Lichenstein, that birds which feed on carrion may probably resort to circular flights, similar to the pigeon, in order to discover a carcass. He remarked, when travelling in Southern Africa, that if an animal chanced to die, in the very midst of the most desert wilderness, in less than half an hour there was seen, high in the zenith, a number of minute objects descending in spiral circles, and increasing in visible magnitude at every revolution. These were soon discovered to be a flight of vultures, which must have observed from a height viewless to the human eye, the dropping of the animal immediately marked out for prey.†

Dr. James Johnstone mentions a fact illustrative of the same

* Ornithological Biography, p. 323. † Travels in Africa.

view. During the north-east monsoon, when the wind blew steadily in one point for months in succession, he observed a concourse of birds of prey from every quarter of the horizon, hastening to a corpse that was floating down the river Ganges. Their sudden appearance he accounts for in the same manner as Professor Lichenstein, by their soaring high in the air in search of food. It could not be owing to the acuteness of scent, as they crowded in from the points from which the wind blew, as well as in the opposite direction. It has indeed been ascertained, by positive experiment, that vultures, and other birds of prey, are guided to their food by the sight, and not by the smell. Audubon, being desirous of satisfying himself on this point, caused a large dead hog to be concealed in a narrow and winding ravine, which was filled with briars and high cane. This was done in the month of July, in a tropical climate, where putrefaction takes place with great rapidity. Yet, though many vultures were seen, from time to time, sailing in all directions over the spot, they seemed perfectly unconscious of its presence, while the dogs found their way to it, and devoured the flesh. On the other hand, when Audubon stuffed a deer-skin full of hay, and laid it down on its back, in the attitude of a dead animal, it was, in the course of a few minutes, visited by a vulture, which tore open the dried skin, and did not retreat till it had torn out large quantities of the hay, and perceived that there was no flesh within. These experiments seem to be conclusive.

EIGHTH WEEK—FRIDAY.

BIRDS.—THEIR VOICE.

When a little quaker girl of my acquaintance was once humming a tune in the presence of a stiff maiden aunt of the same profession, the old lady, scandalized at what she considered an unbecoming levity, said to her reproachfully, 'Rachel, who taught thee to sing?' On which the child archly replied,

It was the little birds, aunt, that taught me to sing.' There was much truth as well as sweetness in this reply. It is the hand of the Creator which has given the power of song to the birds; and it is the same hand which has bountifully gifted man with a musical ear, and a musical voice. The inference is irresistable, that music is intended to add to the enjoyments of the human race; and that to refuse the gift, is to show equal ingratitude to the Giver as when we abuse it.

There is something at once peculiar and delightful in the musical intonations of the feathered tribes, which affords a clear indication of beneficent design. The music of the groves has always been a favourite theme with the poet; and civilized man is probably more alive to the pleasure derived from this source than the savage; but there is no class of rational beings to whom the song of the little warbler is not a source of enjoyment. Let any man consider for a moment how much would be detracted from the delight of the early summer months, if the feathered tribes were dumb, and he will be better able to appreciate the beneficence of the provision, as regards the human race.

But we must never forget, that the Universal Parent has not confined his paternal care to man alone. It is pleasing to see the same attention paid to the lower creation, up to the extent which their humbler sphere requires. The songs of birds, which are so agreeable to us, are probably more delightful, and far more significant to the respective tribes which give utterance to them. They are to them the language of conjugal affection, of parental love, of triumphant exultation, of social enjoyment. They animate and urge forward the labours of nest-building; they cheer the tedium of incubation: they infuse joy into the hearts of the callow brood; they bid defiance to enemies, and inspire friends with confidence.

But the voice of birds is not confined to musical intonations. Their Creator has bestowed upon them the power of communicating with each other in a still more extensive manner; and although they are incapable of uttering articulate sounds, these tribes, as well as other orders of the lower animals, may in a

limited sense be said to possess the power of intercouse by means of a natural language, the utterance of which are instinctively understood by each species respectively. Dr. Macculloch's work contains some curious and ingenious remarks on the language of the lower animals, which may, perhaps, in some particulars, be rather overstrained, but which deserve serious consideration. He alleges, that the ears of these animals are more susceptible of a minute distinction of sounds, than those of the human race; and hence infers, that they have a greater variety in their language than we can properly comprehend. 'In the nightingale and thrush,' says he, 'we distinguish a great number of sounds and articulations, because they belong or approach to that musical scale for which our sense of hearing is adapted. But we cannot doubt, that in these, and still more in birds whose tones are less musical and definite, there are sounds which we do not truly distinguish, and which we, therefore, neglect, in favour of those to which we are most sensible. And there is no difficulty in believing, that the song of a nightingale is better understood by itself than by us, or that it contains much more than we hear. If I were to suggest that it contains a definite set of phrases, with meaning to the animal itself and its kind, there would be nothing absurd in the proposition, since it possesses, even to our ears, a greater variety of articulation than we can find in any human language with which we are acquainted; while, in confirmation of this general view, all who have attended to such subjects must know, that where these birds abound, long debates are often carried on among them, in tones and articulations quite distinct from the ordinary song When we decide otherwise, we are deciding from a prejudice, or assuming that it is not a language, because we do not understand it. We should be equally justified in thus deciding as to the Arabic.'*

Having shown that the lower animals may possess lan-

* Attributes of God, vol. i. p. 559. Dr. Macculloch strengthens his argument by a learned dissertation on the nature of musical sounds, and defects in the human ear, on which I do not think it necessary to enter.

guage more definite than at first sight, we might be inclined to believe, Dr. Macculloch proceeds to instance cases in which this faculty may, at least to a certain extent, be proved to exist. Confining myself at present to the case of birds, I quote the following remarks:—'Familiar examples of various and vocal language exist in the duck tribe, followed by corresponding actions, in marshalling their flights, and in much more. The sounds and articulations of the domestic duck and goose in particular, are so numerous and marked, that they are not equalled by any human language; while it is not difficult to learn the definite, if the general, meaning of many of them. It is not easy to see how else the decoy duck can perform her treacherous office.' 'In the endeavour of birds to persuade their progeny to fly and to dive, we can scarcely avoid believing that we hear a definite language, so unusual, and varied, and marked, are the articulations and the tones. The quarrels of sparrows are more articulate, and the noises more varied, than those of a human contest. The sounds of the domestic fowl under the approach of a hawk, the intention to sit, the calling its young to feed, and much more equally familiar, are not less various and definite. But, not to encumber these pages with facts that all can supply, I need only add the equally noted cases of the cat and the rook. However disagreeable the sounds of the former may be to us, they abound in variety of expression; and in the latter, the comparison of actions and sounds, under a fact of familiar occurrence, renders it scarcely possible to avoid concluding, that the latter constitute a language. The destruction of a rook's nest, occasionally proceeding to the slaughter of the animal, is preceded by a congregation of the society, and a great noise; and all know that the work is executed by the deputation of two or three individuals out of this convention.'

These observations, and others made by this author on the power which the lower animals have of communication by sound, are doubtless founded in truth, although they appear to be carried too far. That birds and other creatures have, to a certain extent, the power of conveying their meaning to

others of their own species, by the different intonations of their voice, there can be no doubt; but it is equally true, that this power is as limited as their mental faculties, and their mutual necessities of communication; and although such a faculty may be dignified by the name of language, yet that term must then be employed in a very restricted sense. As far as it goes, however, it is a provision which must greatly contribute to the happiness of the animals possessing it. The sympathy which is thus created among the members of a feathered family, commencing with the mates when they begin to pair, and extending through all their mutual labours, till the connexion ends, if it does end, in the production and education of the brood, tends, doubtless, to endear and enlarge their intercourse, while it lightens their varied employments; and, in the gregarious tribes, the communication which is thus effected of hope and fear, of pain and enjoyment, as well as of some other kinds of information useful to their subsistence, or their escape from danger, promotes not less truly, though in a less important sense, the welfare of the individuals and of the species; thus affording another instance of paternal regard in the great Author of Nature.

EIGHTH WEEK—SATURDAY.

BIRDS.—THEIR SELECTION OF FOOD.

It is the obvious intention of the Creator that every kind of production fit for the food of animals should be devoured. Nothing can be more curious and admirable than what may be called the economical arrangements which have been adopted for this purpose. Every kind of herb, and flower, and fruit, every kind of succulent vegetable, in short, has some species of living creature which subsists on its produce; and animals themselves are, respectively, objects of preference as food to different classes of the animated creation. Some species, for example, exclusively devour insects, others fishes,

others fowls, and others quadrupeds, while others again are omnivorous. And what is not less worthy of remark is, the nice selection which some animals make, not merely of a particular class of animals or vegetables, but of particular kinds of that class. This is, doubtless, intended by the Author of Nature, for the purpose of insuring a more complete execution of His great design of rendering every thing useful, and thus spreading a 'liberal feast for all that lives.' There is in this appropriation of particular kinds of food by particular animals, an effect produced something analogous to the division of labour. The work is better done.

Among birds, this kind of selection is singular, and a few facts connected with the subject may not be uninteresting. 'Our gardens, shrubberies, and orchards,' says Mr. Knap, speaking of the smaller kinds of birds, 'become their resort, seeking for the fruits usually produced in those places. And first the fannette (*philomela hortensis*), with all its matured brood, is certain to be found feeding voraciously upon our cultivated berries, or mining a hole in the fig or jargonel pear; and so intent are they upon this occupation, that they will permit a reasonable examination of their form and actions; while, at other periods, it is difficult to approach them.' After mentioning also, in his characteristic style, the black cap and the white throat tribes, along with others, he adds:— 'All these fruit-eating birds seem to have a very discriminating taste, and a decided preference for the richest sorts, the sweetest variety of the gooseberry or the currant always being selected; and when they are consumed, less saccharine dainties are submitted to; but the hedge-berry of the season our little foreign connoiseurs disdain to feed on, leaving it for humbler-appetited natives; they are away to sunnier regions, and more grateful food.'*

Mr. Rennie mentions, that these species are equally nice in their preferences and rejections of insects and other small animals, on which they also feed. 'We had a fannette, for example,' says he, 'which was exceedingly fond of spiders,

* Journal of a Naturalist, p. 232, 3d edition.

the largest of which he would contrive to swallow; but the black-cap, though it will devour flies of every sort, will not touch a spider; and while it will eat almost any smooth caterpillar, it will not touch those of the cabbage-butterfly, which the fannette devoured with avidity. Neither of these birds, again, nor the nightingale, will touch an earth-worm, of which the red-breast is very fond. No bird will touch the caterpillar of the magpie moth.'*

There is, then, an obvious choice of food in these birds, which indicates taste; and the same thing may be averred of many other species. It seems difficult, however, to say where this faculty resides, as they swallow their food without mastication, and as their tongues seem generally destitute of those papillæ,† on which the taste of quadrupeds and man depends. Blumenbach and other distinguished naturalists have, indeed, founding on these peculiarities, denied that birds are possessed of the faculty of taste; but their habits prove that they have, at all events, some analogous property which answers the same purpose.

The tastes and preferences of birds with regard to food, are evidently regulated by reference to their organization, there being a beautiful consistency between instincts and bodily conformation, which marks as distinctly as innumerable other adaptations, the work of a Designing Cause. There is a striking passage in Buffon, illustrative of this, which I shall quote entire.

'The mode of life, the habits and economy of animals, are not so free as might be supposed. Their actions result, not from inclination or choice, but are the necessary effects of their peculiar organization and structure; nor do they seek ever to infringe or invade the law of their constitution. The eagle

* Faculties of Birds, pp. 81, 82.

† The flamingo is an exception to this rule, the tongue of this bird being remarkable for being edged with fleshy papillæ, turned backward. This member of the flamingo has been celebrated among epicures since the classic ages, as a great delicacy. Ducks, parrots, and various other birds, are also furnished with papillæ.

never abandons his rocks, nor the heron her shores; the one shoots down from the aerial regions to plunder, or murder the lamb, founding his perscriptive right on strength, his weapons, and his habitual rapine; the other, standing in the mire, patiently expects the glimpse of its fugitive prey. The woodpecker never forsakes the trees round which he is appointed to creep; the snipe must for ever remain in the marshes, the lark in its furrows, and the warbler in its groves. All the granivorous birds seek the inhabited countries, and attend on the progress of cultivation; while those which prefer wild fruits and berries, perpetually fly before us, and cherish the wilds, and forests, and mountains; there, remote from the dwellings of man, they obey the injunction of Nature. She retains the hazel-grous under the thick shade of pines; the solitary blackbird under his rock; the ousel in the forests, which resound with its notes; while the bustard seeks its subsistence on the dry commons, and the rail in wet meadows. Such are the eternal, immutable decrees of Nature, as permanent as their forms; these great possessions she never resigns, and on these we vainly hope to encroach. And are we not continually reminded of the weakness of our empire? She obliges us even to receive troublesome and noxious species: The rats make a lodgement in our houses, the martins in our windows, the sparrows in our roofs; and when she conducts the stork to the top of our old ruinous towers, already the habitation of the mournful family of nocturnal birds, does she not hasten to resume the possessions which we have usurped for a time, but which the silent lapse of ages will infallibly restore to her?

'Thus the numerous and diversified species of birds, led by instinct, and confined by their wants to the different districts of Nature, have apportioned among themselves the air, the earth, and the water. Each holds its place and enjoys its little domain, and the means of subsistence which the peculiarities of its faculties will augment or abridge. Thus the spoonbill seems formed for gathering shell-fish; the small flexible strap, and the reflected arch of the avoset's bill, reduce

it to live on fish spawn ; the oyster-catcher has an axe-shaped bill, calculated for opening the shells ; and the crossbill could not subsist, were it not dexterous in plucking the scales from the fir cones. Lastly, the shearbill could neither eat sidewise, nor gather food, nor pick forwards,—its bill consisting of two pieces extremely unequal, the lower mandible being long, and extended disproportionally, projects far beyond the upper, into which the latter falls like a razor into its haft.'*

NINTH WEEK—SUNDAY.

THE ASCENSION OF CHRIST.

After his resurrection Jesus remained for forty days on the earth, appearing occasionally to his disciples, and instructing them in heavenly truths ; and it was about this season of the year that 'He led them out as far as Bethany, and he lifted up his hands on them and blessed them ; and it came to pass, while he blessed them, that he was parted from them, and carried up into heaven. And they worshipped him, and returned to Jerusalem with great joy.'

On the first glance, it may appear strange and unnatural that the disciples should rejoice at an event which deprived them of the personal presence of their beloved Master, in

* *Oiseaux, Art : Le Bec-en-oiseaux.*—Buffon seems not duly to appreciate the wisdom of this contrivance in the shearbill, and in his observations on the subject, casts reflections on Creative Intelligence. He speaks of it as 'an awkward and defective instrument ; yet he himself informs us, that 'it flies skimming the surface with its lower mandible cutting the water ;' and he quotes M. de la Borde, who says that it is with this very instrument that it seeks for its prey below the surface of the water, 'and when it feels a fish it closes both mandibles.' The truth is, that the instrument, so far from being 'awkward and defective,' is most admirably suited to the peculiar instinct of the bird ; and, on account of its singularity, is calculated advantageously to show the reciprocal adaptation of habits to instruments, and instruments to habits.

whose society they had hitherto received so much instruction and delight; but if we consider their situation, and the circumstances attending this wonderful event, a little more minutely, we shall see the matter in another light. It was awful and heart-rending, indeed, to see Him whom they loved, expiring on the cross; but his departure was now stripped of all that could give pain to the generous heart; and their attachment to him was too sincere and disinterested to permit them to place their own selfish interests in competition with his happiness. This event restored him to the bosom of his Heavenly Father; and they must have remembered the irresistible appeal which he had himself made to their feelings on the very night before he suffered:—'If ye loved me ye would rejoice.' Besides, they consoled themselves with the blessed assurance that he was only parted from them for a season, and that after a few fleeting years of earthly pilgrimage, they would be re-united to him in the regions of eternal glory. This ground of consolation he had also suggested to them on the same occasion;—'I go,' said he, 'to prepare a place for you; and I will come again to receive you to myself, that where I am there ye may be also.' In a word, the hope of earthly power and greatness, which they had formerly cherished, they now found to be delusive; but their hearts were purified from worldly affections, and in the ascension of Jesus they contemplated the pledge of celestial enjoyments, infinitely more substantial and durable in their nature, and inconceivably better suited to the spiritual faculties of the soul.

These sources of pleasure in the contemplation of the Saviour's ascension, must have been experienced in a peculiar degree by the apostles, who felt for him an attachment of *personal* friendship which we cannot feel, and which must have been much more tender and ardent than can warm our hearts towards Him, 'whom, having not seen, we love.' But there are circumstances attending this glorious event, in which all true Christians are equally interested, and from

which they may all equally derive unspeakable comfort and joy.

The assurance that Christ has ascended 'to his Father and our Father, to his God and our God,' adds confidence to our faith. It is true that our faith would, even without this event, have rested on the immoveable foundation of the promises of God, and the dying declaration of the Saviour, that all was finished. But there is something more satisfactory, and better suited to the imperfect state of our faculties, in the visible display which God has condescended to give of his love to Jesus, by publicly raising him from the dead, and opening the heavens to receive him. There are here substantial facts on which the mind can rest. The salvation of the world is no longer a matter of faith, but of vision. It is brought, as it were, within the evidence of the senses; and the testimony of men is made to concur with the declarations of God.

Another source of pleasure in the contemplation of Christ's ascension, is the belief that he is gone to appear before the throne of God as our mediator and advocate. Men have, in all ages, looked for some intermediate step between themselves and their Creator; some being, less awful in the majesty of his attributes, and approaching nearer to a level with the weakness of humanity, who might lend a favourable ear to their petitions, and, presenting himself before the throne of the Eternal in their behalf, might ensure an answer of peace. Hence, into the idolatrous worship of antiquity was introduced that host of deified men, and subordinate divinities, whose temples were decorated with more profuse magnificence than those of the Supreme God, and whose altars smoked with more numerous and costly victims. What, in the fondness of their hearts, the blind imaginations of the heathen only superstitiously conceived, the religion of Jesus has in reality provided. Our 'Great High Priest is passed into the heavens,' and 'is seated at the right hand of God.' Through him we are directed to make our wants known at the throne of grace; and we are assured that whatsoever we shall ask the Father in his name, he will be ready to grant. Nay, further, for the unspeakable comfort of

those humble and contrite spirits whose hearts are broken under a sense of guilt, we are informed that, 'If any man sin he has an advocate with the Father, Jesus Christ the Righteous, and he is a propitiation for our sins; and not for ours only, but also for the sins of the whole world.'

For an office so important and so endearing, the Son of Man is indeed eminently qualified. He partakes of our nature, and therefore knows our weaknesses, and the force of our temptations; he has suffered, and will therefore sympathize in our distresses. But, in contemplating Jesus as his intercessor and advocate, the circumstance on which the Christian rests with peculiar satisfaction, is the tender sensibility and compassion of his nature. I do not merely allude to that pity for the human race which induced the Son of God to assume the nature of man, and to become a man of sorrows, —though this is much,—but chiefly to that tender and melting sympathy, which made him enter into the afflictions of others, and feel them as his own. There is an exquisite grace in this part of our Lord's character, which it is impossible to view without emotion. When we hear him comforting his disciples, we feel for him the affection of a friend,—when we see him tenderly soothing the mourning sisters of Lazarus, and mingling his tears with theirs, we love him as a brother; but when we observe him, in the agonies of the cross, praying for his murderers, there is an interest excited in our hearts which language has no words to describe. To the believer this sentiment is inexpressibly delightful and endearing, as he is taught to conclude, that this divine compassion is exercised towards himself. Jesus is 'also touched with a feeling of our infirmities.' He has carried with him into heaven all that love for the children of men which he displayed whilst on earth. Of all who believe in his name, there is not a single individual in whose welfare he does not feel a tender and affectionate interest. He takes a part in all our joys and sorrows. He makes use of that divine authority with which he is invested, to cause all things to work together for our good.

What an amiable view does this afford us of the Divine

administration! How admirably is it calculated to interest the best affections of the heart in the cause of religion; to draw us by the cords of love to the service of the Redeemer; and to give new energy to our faith, boldness to our hope, and relish to our enjoyments! 'Wherefore, holy brethren,' says Paul, 'partakers of the heavenly calling, consider the apostle and high priest of your profession, Christ Jesus; and come boldly unto the throne of grace, that you may obtain mercy, and find grace to help in the time of need.'

NINTH WEEK—MONDAY.

BIRDS.—THEIR GREGARIOUS HABITS.

One of the most remarkable instincts of the lower animals, is that which induces them to congregate together for some mutual object; and this propensity is attended with other instinctive habits, which seem necessary for giving the arrangement full effect in producing the intended object. The gregarious habits of the ant and the bee among insects, have long been a subject of admiration; and although in no case do we find these habits so perfect among the higher orders of the inferior creation, yet neither among birds nor beasts are they altogether wanting.

I have already noticed the propensity of various species of birds to congregate during the breeding season, and for the purpose of migration. But there are other occasions in which there is obviously a mutual understanding among various families of the feathered tribes, and a banding together for objects of reciprocal advantage. The chief inducement to this social disposition, appears to be to guard against common dangers. It would seem that many of the smaller birds are more timid when solitary, than when in the company of their kind; and that some sort of sympathetic feeling is diffused through a flock, which, while it probably affords a social pleasure, increases in each a sense of mutual security. This may

certainly be the case, even although they do not combine to defend themselves against a common enemy. It is well known, that various species of birds, when they feed in company, have watchers or sentinels placed on some elevated situation, to give them warning on the approach of danger. When a flock of sparrows, for example, alight in the corner of a wheat field, we may always be certain of discovering one, or perhaps several, perched on some high spray in the adjoining hedge-row, prying into the probable design of every movement among men or animals, which lies within observation. The instant the sentinel perceives any thing which he deems worthy of notice, he gives his well-known signal, at which the whole flock hurry off from the banquet with the utmost celerity and trepidation. These fears are for the most part only momentary; for, as soon as the birds ascertain that there is no immediate danger, they hasten back to finish their meal, or light on some other part of the field, where they again feed under the protection of their sentinels.

'From all that we have been able to observe,' says Mr. Rennie, 'there does not seem to be any thing like election or appointment of such sentinels. The fact appears rather to be, that, probably from being less impelled by the calls of hunger, the bird of the flock who chances to be the last in adventuring to alight, feels then reluctant to join his companions, in consequence of an instinctive foresight that they might all be thence exposed to danger.' Whatever truth there may be in this, the paternal intention of the Creator in implanting the instinct is sufficiently conspicuous.

Rooks seem to be more particular even than sparrows, in having sentinels while they are feeding in parties after the breeding season. These rook-sentinels are so vigilant, that it is by no means easy to get within shot of a foraging party; and hence it is popularly believed that rooks can smell gunpowder. Although this is a mistake, they do appear to have some knowledge of the danger arising from fire-arms, as any one may prove by levelling a walking-cane at a flock, when they will instantly fly off in great alarm. Such knowledge

must be derived from experience. In confirmation of this, it is stated in some accounts of newly discovered countries, that the birds were not at first frightened by the presenting of a fowling-piece, but soon became so after some experience of its effects.

The golden plover and the crane seem each to have a kind of king or leader, whom the whole flock obey. The latter class Aristotle places at the head of gregarious birds; and Pliny says, that their sentinels 'stand on one foot, and hold a little stone within the other, which, by falling from it, if they should chance to sleep, might awaken them and reprove them for their negligence.' We are not obliged to believe this, although the historian Ammianus Marcellinus informs us, that, in imitation of their ingenuity, Alexander the Great was accustomed to rest a silver ball in his hand, suspended over a brass bason, which, if he began to doze, might, by falling, give an alarm, and preserve his vigilance.*

We do not often find instances among birds of mutual assistance, afforded in carrying on a common work, such as is frequently met with among insects, and sometimes, but much more rarely, among quadrupeds, of which latter instinct the beaver is a memorable example. But besides the instance of the grosbeaks of Africa, which are said to unite their labours in building their nests, there are some well-attested cases of an occasional union of birds of the same species, to effect a special purpose. That of swallows to entomb a robber sparrow in an usurped nest, has already been mentioned.†

M. Dupont de Nemours gives another instance of the so-

* Apud Aldrovandi Ornith. vol. iii. p. 137.

† 'Spring.'—Article, Nests of Swallows.—Such a feat has been confidently rejected by Mr. Rennie as imaginary, on the ground of 'the impossibility of so entombing by means of clay, a bird with so powerful a bill as a sparrow.'—*Habits of Birds*, p. 55. A sufficient answer to this theoretical objection may be given in the words of a character in the Castle Spectre, 'I did not say it was *possible*, I only said it was *true*.' The bird is probably on such occasions terrified at its unusual situation, and so stupified as not to be aware that it could by its own exertions extricate itself.

cial instinct of the swallow exerting itself in a singular way, which fell under his own observation. The following is his account:—'I remarked a swallow which had unhappily,—and I cannot imagine in what manner,—slipped its foot into a slip-knot of packthread, the other end of which was attached to a spout of the College of the Four Nations. Its strength was exhausted; it hung at the end of the thread; uttered cries, and sometimes raised itself, as if making an effort to fly away. All the swallows of the large basin between the bridges of the Tuilleries and the Pont Neuf, and perhaps from places more remote, had assembled, to the number of several thousands. Their flight was like a cloud; all uttered a cry of pity and alarm. After some hesitation, and a tumultuous council, one of them fell upon a device for delivering their companion, communicated it to the rest, and began to put it into execution. Each took its place; all those who were at hand went in turn, as in the sport of running at a ring, and, in passing, struck the thread with their bills. These efforts, directed to one point, were continued every second, and even more frequently. Half an hour was passed in this kind of labour before the thread was severed, and the captive restored to liberty. But the flock, only a little diminished, remained until night, chattering continually in a tone which no longer betrayed anxiety, and as if making mutual felicitations and recitals of their achievements.'*

* *Antoine, Animaux celebres*, vol. ii. App. p. 18.—Mr. Rennie, with unnecessary scepticism, also doubts the accuracy of this narrative. There may probably be in it some characteristic painting; but the leading fact is very analogous to that of building up the sparrow, and may be equally credited, notwithstanding its singularity

NINTH WEEK—TUESDAY.

DOMESTIC FOWLS.—THE COCK, THE TURKEY, AND THE PEACOCK.

Having already given an account of some of the more remarkable faculties and habits of birds, I shall only select one or two species for particular description; and that which claims our first notice, on account of its usefulness to the human family, is the tribe of domestic fowls, in its different varieties. This species of birds is connected with a class, all of which seem to be intended for the special use of man, being of white and delicate flesh, and having short and concave wings, which prevent them from making long flights, and confine them much to the same locality; while they are quite harmless, and most of them easily tamed. Among these we may rank the common cock, the peacock, the turkey, the guinea-hen, the pheasant, the bustard, the grouse, the partridge and the quail. To the four first only the title of domestic fowl applies. They all bear a strong similitude to each other, being all granivorous, and equally delicate to the palate. They are, among birds, what beasts of pasture are among quadrupeds, peaceable tenants of the field, shunning the thicker parts of the forest, where they would encounter numerous animals which would mark them for their prey.

The various kinds of domestic fowl are gregarious both in their wild and tame state. The most courageous male conquers for himself a seraglio of female dependants, who willingly live under his sway, although they seem to have no exclusive preference for him; and if he be finally subdued in the combat, his rival takes undisputed possession both of the locality in which he moved, and of his wives, while he sinks into unpitied insignificance. Hence the proverbial courage of the dunghill cock. He fights for all that gives relish to his existence.

The power of domestication, in causing alterations, not on-

ly in the habits, but in the appearance and form of animals, is no where more strongly exemplified than in the cock. He seems to be, of all the birds, the oldest companion of man, having been, in very early ages, reclaimed from the forest, and taken to supply the accidental failure of the chase. It is probably on this account that he exhibits such interminable varieties in plumage and in form. 'The tail,' says Goldsmith, 'which makes such a beautiful figure in the generality of these birds, is yet found entirely wanting in others; and not only the tail, but the rump also. The toes, which are usually four in all animals of the poultry kind, yet in a species of the cock, are found to amount to five. The feathers, which lie so sleek, and in such beautiful order in most of those we are acquainted with, are, in a peculiar breed, all inverted, and stand staring the wrong way. Nay, there is a species, that comes from Japan, which, instead of feathers, seems to be covered all over with hair. These, and many other varieties, are to be found in this animal, which seem to be the marks this early prisoner bears of his long captivity.'*

The cock seems first to have been introduced into Europe from Persia, as Aristophanes calls it the *Persian bird;* but it is no longer found wild in that country. It is only in some of the Islands of the Indian Ocean, and along the Malabar coast, that this fowl is known to exist in its ancient state of independence. In his wild condition the plumage of the cock is black and yellow, and his comb and wattles yellow and purple. In the Indian species there is another peculiarity. Their bones, instead of being white as with us, are as black as ebony, arising probably from some quality in their food; which may be conjectured from the well-known fact, that the bones of fowls fed on madder are tinctured red.

The turkey is the kind of poultry next in repute as a domesticated fowl. It is a native of America, where it is still found in abundance in the woods, and where it is much larger, and more beautiful than in its state of domestic captivity. There their feathers are of a dark grey, bordered at

* Goldsmith's 'Animated Nature.'—Article, the Cock.

the edges with a bright gold colour. It was transported to Europe immediately after the conquest of Mexico, and was first introduced into England during the reign of Henry VIII.

The habits of this bird, in a state of nature, are singular. To some of these I have elsewhere adverted, in speaking of their reproductive instincts.* They are gregarious, and seldom mount on the wing, unless forced by pursuit, or when it is necessary to cross a river in their migrations in search of food. In the latter case, their mode of operation is worthy of being recorded. When they find their progress interrupted by a river, they stop short for a day or two, as if for the purpose of consultation. During this time, the males are heard gobbling and calling, and are seen strutting about apparently full of important business. Even the females and the young seem to partake of the excitement, spreading out their tails, taking extravagant leaps, and running round each other with a loud *purring* noise. At length the whole party mounts to the tops of the highest trees, whence, at a signal, consisting of a single *cluck*, given by a leader, the flock takes flight for the opposite shore. The old and fat birds easily get over, even though the river be a mile in breadth; but the younger and less robust frequently fall into the water, not, however, to perish; for here an instinct is bestowed on them, suited to the emergency. They bring their wings close to their body, spread out their tail as a support, stretch forward their neck, and, striking out their legs with great vigour, proceed rapidly towards the shore. When they reach the opposite bank, should they find it too steep for landing, they cease their exertions, and allow themselves to be floated down the stream, till they reach an accessible part, when, by a violent effort, they extricate themselves from the water. The turkey is said to be a stupid animal; and certainly some of its actions indicate little forethought or contrivance; but, in these particulars, the instinct of self-preservation, impressed on them by their Maker, is powerful and ingenious.

The following account is given by Goldsmith, of the man-

* 'Spring,' pp. 182, 183.

er of hunting this bird in its wild state among the savage tribes of its native country:—'When the hunter has discovered the retreat of a flock, which is generally near fields of nettles, or where there is plenty of any kind of grain, he takes his dog with him, which is trained to the sport (a faithful rough creature, supposed to be originally reclaimed from the wolf), and sends him into the midst of them. The turkeys no sooner perceive their enemy, than they set off, running at full speed, and with such swiftness that they leave the dog far behind them. He follows nevertheless; and, sensible that they must soon be tired, as they cannot go full speed for any length of time, he at last forces them to take shelter in a tree, where they sit, quite spent and fatigued, till the hunter comes up, and with a long pole knocks them down one after the other.'

In illustration of the power already adverted to, which birds possess, of marking their enemies at a distance, and of making their meaning known by the sounds they utter, I may quote the following interesting account of the Abbé de la Pluche:—'I have heard a turkey-hen,' says he, 'when at the head of her brood, send forth the most hideous screams, without knowing, as yet, the cause; however, her young, as soon as the warning was given, skulked under the bushes, the grass, or whatever else offered for shelter or protection. They even stretched themselves at full length upon the ground, and continued lying as motionless as if they were dead. In the mean time, the mother, with her eyes directed upwards, continued her cries and screaming as before. Upon looking up to where she seemed to gaze, I discovered a black spot just under the clouds, but was unable at first to determine what it was; however, it soon appeared to be a bird of prey, though at first at too great a distance to be distinguished. I have seen one of these animals continue in this violently agitated state, and her whole brood pinned down as it were to the ground, for four hours together, whilst their formidable foe has taken his circuits, has mounted, and hovered directly over their heads. At last, upon his disappearing, the parent began to change

her note, and sent forth another cry, which in an instant gave life to the whole trembling tribe, and they all flocked round her, with expressions of pleasure, as if conscious of their happy escape from danger.'

There are probably other gallinaceous birds besides the turkey found in America, which might be advantageously domesticated in Europe, among which the curassows have been particularized. This tribe can be tamed with the greatest ease, and is held in high estimation in many parts of South America.

Of the peacock, it is not necessary to say more than that it is at once the most beautiful in plumage, and the harshest in voice, of any of the feathered tribes taken under the protection of man; and its insatiable gluttony, and spirit of depredation, make it at the same time the most troublesome of the domestic birds. The Italians have an appropriate aphorism, characterizing it as possessing the plumage of an angel, the voice of a fiend, and the stomach of a thief.

NINTH WEEK—WEDNESDAY.

DOMESTIC FOWLS.—THE GOOSE AND THE DUCK.

Besides different species of the poultry class, already mentioned, men have domesticated two kinds of water-fowl, the goose and the duck. They are each esteemed as food, and the former is also of great value, both on account of the quills which it yields for writing, and of the feathers, which are employed so universally among civilized nations as a soft and comfortable bed. The habits of the domestic goose are well known; but its dull appearance, and the cackling sound it emits when disturbed, have procured for it a character for stupidity which it does not deserve; while a single incident, perhaps fabulous, has stamped it with a character for vigilance which seems equally exaggerated in another direction. A

few remarks will serve to correct both of these popular notions.

With regard to extreme vigilance, the story of a flock of geese having saved the Roman capitol, is well known to every scholar. This story has induced some to attribute to the goose great acuteness of hearing, and others to allege that, by the smell, it 'scents the odour of man at a great distance.' Both of these opinions are now believed to be fallacious; and, if the account be any thing better than a legend, the fortunate vigilance of the geese on the occasion alluded to, must have been owing, as Albertus Magnus has remarked, to the lightness with which they are known to sleep, which causes them to be awakened by the slightest noise.

That the goose is not so stupid an animal as is generally supposed, may be inferred from many facts. The anecdote elsewhere mentioned, of the gander which roused the family when a polecat had attacked his mate on her nest, is a case in point.* The following account, which is given on the authority of the respectable individual who was the object of the animal's attachment, shows that the goose is possessed of both warm affections, and considerable sagacity. A bird of this species, whose name was *Jacquot*, had been kindly treated and liberally fed by the narrator; and, one day, on going from home, this gentleman had passed through the barn-yard, and noticed his favourite gander as usual. The narrative thus proceeds:—'He no sooner saw himself separated from me, than he vented strange cries. However, I went on my road, and had advanced about a third of the distance, when the noise of a heavy flight made me turn my head, and I saw Jacquot only a few paces from me. He followed me all the way, partly on foot, and partly on the wing,—getting before me, and stopping at the cross paths, to see which road I intended taking. Our journey lasted from ten in the morning to eight in the evening, and my companion followed me through all the windings of the wood, without seeming to be tired. After this he attended me every where, so as to be-

* 'Spring.'—Article 'Parental Affection.' Note.

come troublesome, for I was not able to go to any place without his tracing my steps; so that, one day, he even came to find me in the church. Another time, as he was passing by the rector's window, he heard me talking in the room; and, as he found the door open, he entered, climbed the stairs, and marching in, gave a loud exclamation of joy, to the no small affright of the family.' The sequel of the story is distressing. His attachment became so inconvenient, that it was necessary to shut him up, which caused him to pine. His inquietude lasted about a year, when he died of vexation.

Wilson mentions the case of a wild goose, which, having been wounded, and taken alive, by a Mr. Platt, a farmer on Long Island, was placed among his tame geese, and soon became quite familiar. One day, however, in the following spring, the goose hearing the bugle-note of the leader of a flock, as they passed over the barn-yard, in their annual migration to the northern regions, 'spread its wings, mounted into the air, and was soon out of sight.' In the succeeding autumn, Mr. Platt happened to be standing in his barn-yard when a flock of these wild geese, on their return to the south, passed over his head. 'At that instant he observed three geese detach themselves from the rest, and, after wheeling round several times, alight in the middle of the yard. Imagine his surprise and pleasure, when, by certain well-remembered marks, he recognized, in one of the three, his long-lost fugitive.' She had hatched and reared her offspring in the distant lakes of the north, 'and had now returned, with her little family, to share the sweets of civilized life.'

A similar anecdote of the tame goose was frequently related in my hearing, by a neighbouring clergyman, of unquestionable veracity, now dead.* His parish was bounded on one side, like my own, by the Solway Frith; and a flock of geese from the opposite county of Cumberland, where they are reared on extensive commons, having, by some accident, crossed over to the Scottish side, enticed a solitary pair, belonging to my friend, to elope with them. They were given over for

* The late Dr. M'Morine of Carlaverock.

lost; but, about the end of autumn, he was astonished to observe the arrival of a considerable flock at his barn-door. He quickly recognized, in the leaders of the flock, the pair which had deserted him in the preceding spring. The rest, amounting to eight or ten young ones, full-fledged, and well grown, he did not doubt were the progeny of the truant birds, in the summer residence they had chosen for themselves.

The flight of wild geese is very remarkable, and shows, if not a wisdom of their own, at all events an implanted instinct, which indicates a practical knowledge of the principles of ærostation. They place themselves in two oblique lines, forming an angle, or in a single line, where the flock is not very numerous. The bird that is at the head of the angle, or the line, and thus cuts the air first, retires, when fatigued, to regain his strength in the last rank, and the others take his place in their turns. There is a marked combination and intelligence in this arrangement; for it is the most favourable for each individual, and enables the entire flock to glide through the air with the least fatigue.

The duck is of another aquatic species, and has habits peculiar to itself. In conformation it differs from the goose, in various particulars sufficiently marked; among which are, a smaller body, less extended wings, a shorter neck, a bill slenderer at the base, and thicker towards the tip, and legs placed farther back on the body. In many points, however, these two classes agree, and indeed have a nearer affinity than usually belongs to different species in other departments. The alterations produced on them by their domestic habits, in a long series of ages, have caused the goose and the duck to differ as much from the wild sorts of their own species, as, in some of the kinds, they differ from each other. Of both, the most obvious distinction from the other feathered tribes, lies in the bill, which is broad and flat, being intended for shovelling up their food, and is sheathed with a skin which covers them all over.

There are considerable varieties among the duck species ten different sorts of the tame kind being enumerated, and

more than twenty of the wild. They may, however, be separated into two groups, the one distinguished by having the thumb or great toe bordered by a membrane, the other by the want of this appendage, while they are smaller in the head, longer in the legs, and altogether more graceful and more active.

The most celebrated of the wild species is the eider-duck, which is found in great abundance in the north of Europe and America. In Norway, where it particularly abounds, the natives have cruelly converted one of the most interesting of instincts, into a means of gratifying their cupidity. It is well known that the maternal solicitude of the eider-duck leads her to line her nest with the down plucked off her own breast, which is in great request on account of its beauty and warmth. When the inhabitants find one of these nests, they carefully collect and remove the down and eggs. The bird soon lays again, and covers the eggs with fresh down, which she again plucks from her breast. When she has repeated this operation, three several times, she has exhausted the supply from her body; and it is said that the male bird then comes to her assistance, and covers the eggs with down from his own breast. Half a pound weight of down may thus be collected from a single nest, during the breeding season, which is of such extraordinary elasticity, that three quarters of an ounce will fill a large hat. It is indeed at once the softest, the warmest, and the lightest substance with which we are acquainted.

It is curious to see similar instincts occurring in orders far apart from each other. The gipsy-moth and the rabbit, both in a similar manner, line their nests with down plucked from their bodies, affording remarkable instances of the analogies which are found every where meeting and surprising the inquirer into nature.

NINTH WEEK—THURSDAY.

BIRDS OF PREY.—THE VULTURE.

Passing over all the other species of the feathered family, each of which has its use in the economy of nature, I shall conclude this section of my work, by noticing two orders of birds, in some respects nearly allied to each other, yet each occupying its own distinct position, and fulfilling its own peculiar intention; I allude to the vulture and the falcon tribes, the one designed to devour animals already dead and undergoing the process of decay, the other to preserve within due bounds the animated creation, by taking living creatures for its prey. Of both of these classes there are many varieties, suited to different localities and different climates. As types of the whole of these classes, I shall select one or two examples of each.

I begin with the vulture, and of this genus the American condor first presents itself as appropriate on account of its superior size. The immense mountain chain which runs down the continent of South America, is the native stronghold, where these birds dwell in security. In Peru and Chili, they are even abundant, but are seldom seen in flocks of more than three or four together. There, in the regions of perpetual snow and terrific storms, 15,000 feet above the level of the sea, on some isolated pinnacle, some horrid crag, the condor rears its brood, and looks down with piercing eye upon the plains beneath, yet far away, for food. Like the rest of its family, it feeds on carrion, and gorges itself to disgusting repletion, so as to become incapable of flight In this state it is often captured; and the Indians are accustomed to expose the dead body of a cow or a horse, so as to attract the notice of these birds, as they are seen sailing in the sky. Down they sweep, and glut themselves with the luxurious banquet, when the Indians appear with their lassos,* throw them with unerring

* The lasso is a cord with a slip loop, which the natives use with great

certainty, and gallop away, dragging after them the ensnared victims. These gigantic birds, which are in length between three and four feet, and from nine to ten in expanse of their wings, are by no means formidable; they are not ferocious, and their talons, not being intended to seize living prey, are too feeble to lacerate. The natives do not fear them, and are accustomed, with their children, to sleep near their resort, exposed to attack, were this ever to be apprehended. Of the strength of the condor, and its tenacity of life, we have many authentic accounts. Captain Head relates an attempt of one of his Cornish miners to overcome one of these animals gorged with food, when, after a severe struggle of an hour, the man was obliged to leave his victory incomplete. Humboldt mentions the particulars of a cruel experiment made by some Indians in his presence, to show the strength of the condor's vital powers. It was hanged by the neck on a tree for several minutes and pulled forcibly by the feet, yet, when released, it rose and walked about as if nothing had occurred to affect it. It was then shot at with a pistol within four paces, and it was not till the fourth ball struck its thigh, that it was brought to the ground; nor did it die of its wounds till after an interval of half an hour.

While sailing at ease in the air, the condor exhibits a noble spectacle of grace and majesty, which cannot be regarded without admiration. To see him with expanded wings, wheeling round the topmost summits of the Andes, or sweeping down in a series of gyrations from the upper sky, each circle contracting as the earth is neared, is represented by travellers as a sublime and imposing sight.*

The vulture is found in most parts of Europe, where it pursues its useful office of destroying dead carcasses; but it is chiefly numerous in the warmer regions of the earth, where decomposition goes on rapidly, and the noxious effluvia arising from decaying animal substances might, without the inter

dexterity on horseback, in seizing the wild cattle and horses which abound in South America.

* 'Introduction to the Study of Birds,' pp. 24, 25.

ference of this bird, be both annoying and destructive. In Egypt, the vulture is of singular service. There are great flocks of them in the neighbourhood of Grand Cairo, which no person is permitted to destroy. The service which they render the inhabitants is the devouring of all the carrion and filth of that great city. 'They are commonly seen,' says Goldsmith, 'in company with the wild dogs of the country, tearing a carcass very deliberately together. This odd association produces no quarrels; the birds and quadrupeds seem to live amicably, and nothing but harmony subsists between them. The wonder is still the greater, as both are extremely rapacious, and both lean and bony to a very great degree, probably having no great plenty, even of the wretched food on which they subsist.'*

The vulture may be justly called the scavenger among the winged tribes. For this important, though ignoble department, it is admirably fitted by Nature. Its far-seeing eye, its powerful wing, its rapacious appetite, its decided preference for carrion, all mark it out as appointed to this special office by the fiat of its Maker. It fulfils its appointed duty with wonderful efficiency. Of one species, the griffon, which is widely diffused, it is said by a celebrated naturalist, that 'when once it has made a lodgement on its prey, it rarely quits the banquet while a morsel of flesh remains, so that it is not uncommon to see it perched upon a putrefying corpse for several successive days.' Of another, which inhabits the south of Africa, Kolben says, 'I have been often a spectator of the manner in which they have anatomized a dead body; I say anatomized, for no artist in the world could have done it more cleanly. They have a wonderful method of separating the flesh from the bones, and yet leaving the skin quite entire.' Of all the different kinds, it may be said in general, that nature has bestowed upon them a most voracious and almost insatiable desire to devour, under different habits suited to their respective localities.

There is in this genus a remarkable instance of the ten-

* Animated Nature,—Article Vulture.

dency in nature, already noticed, of one group of animals to pass insensibly, and by intervening forms and instincts, into another. I allude to the lämmergayer, or bearded vulture, a species nearly allied in many particulars to the eagle family, and yet possessing too many characteristics of the class we have been considering, to suffer us to mistake its true place among the winged tribes. This bird emulates the eagle in its daring and rapacious habits. 'Sailing in the air above the snow-clad summits of the stupendous Alps,' says the author of a recent publication, 'it watches until the unwary chamois approaches the edge of a precipice, or traverses the pass of a narrow ledge, and then, sudden and impetuous as the avalanche of its native regions, down it rushes, hurling the helpless animal into the abyss below; when, proudly whirling round for a few gyrations, as if to contemplate the effects of its sanguinary deed, it plunges down to gorge on the yet quivering flesh.' Bruce, in his 'Travels,' gives a remarkable instance of the boldness and voracity of this bird. His servants were preparing dinner on the summit of a lofty mountain, when a bearded vulture slowly advanced, and at length fairly seated himself within the ring which they had formed. The affrighted natives started up, and ran for their lances and shields; and the bird, after an ineffectual attempt to extract a portion of their meat from the boiling water, seized a large piece in each of his talons from a platter that stood by, and carried them off slowly along the ground as he came. After an interval of a few minutes, the vulture returned for a second freight, but was shot by the traveller before it could carry its purpose into effect.

NINTH WEEK—FRIDAY.

BIRDS OF PREY.—THE EAGLE.

The eagle, which, like the lion among quadrupeds, is the acknowledged king of that division of nature to which it be-

longs, is ranked among the order of falcons. The following spirited description of it is given by a recent writer on the natural history of birds:—'They live by slaughter; they carry on a war of ruthless extermination, and surround their lonely nests with the relics of many a bloody feast. Their port is free and noble, their eyes piercing, their body firm and compact, their flight rapid and impetuous, their beak and talons are hooked, sharp, and formidable. They live alone, or in pairs; some on the cliffs of the sea-shore, some on the highest mountains, some among the secluded recesses of the woods, and some on wide heaths and moors. All are busy and active in the destruction of life. Some, perched on a rocky height, or on the topmost branches of a tree, mark their prey at a distance, and rapid as an arrow, launch upon the fated quarry; some skim our fields and woods, and pounce sudden and silently on the unsuspecting victim; they soar aloft, and sweep down like a thunderbolt upon their prey while in the air; or glide upon it obliquely, and thus skim it from the surface of the earth. All, however, are not of equal courage; some attack birds and quadrupeds larger than themselves, and capable of making resistance; others content themselves with feeble animals, lizards, snakes, frogs, mice and the like. The females exceed the males in size and powers.'*

From this numerous and diversified class, I select the white-headed eagle of America, which is emblazoned on the national standard of the United States, and is spread nearly over the whole northern division of the New World I do this for two reasons; first, because it is one of the most powerful of the eagle family, and furnishes in itself an example of a bird which feeds on prey both from the land and waters; and, secondly, that I may have an opportunity of introducing the graphic and spirited description of two eminent and eloquent naturalists, who bring, as it were, before our very eyes this tyrant and scourge of the inferior creation. The following is Audubon's account of the royal bird's manner of capturing the wild swan:—

* Study of Birds, pp. 35, 36.

'To give you some idea of the nature of this bird, permit me to place you on the Mississippi, on which you may float gently along, while approaching winter brings millions of waterfowl, on whistling wings, from the countries of the north to seek a milder climate in which to sojourn for a season. The eagle is seen perched in an erect attitude on the highest summit of the tallest tree, by the margin of the broad stream. His glistening but stern eye looks over the vast expanse; he listens attentively to every sound which comes to his quick ear from afar, glancing now and then on the earth beneath, lest even the light tread of the fawn may pass unheard. His mate is perched on the opposite side, and, should all be tranquil and silent, warns him by a cry to continue patient. At this well known call the male partly opens his broad wings, inclines his body a little downwards, and answers to her voice in tones not unlike the laugh of a maniac. The next moment he resumes his erect attitude, and again all around is silent. Ducks of many species, the teal, the widgeon, the mallard, and others, are seen passing with great rapidity, and following the course of the current, but the eagle heeds them not. They are at that time beneath his attention. The next moment, however, the wild, trumpet-like sound of a yet distant, but approaching swan, is heard. A shriek from the female eagle comes across the stream; for, kind reader, she is fully as alert as her mate. The latter suddenly shakes the whole of his body, and with a few touches of his bill, aided by the action of his cuticular muscles, arranges his plumage in an instant. The snow-white bird is now in sight; her long neck is stretched forward; her eye is on the watch, vigilant as that of her enemy; her large wings seem with difficulty to support the weight of her body, although they flap incessantly. So irksome do her exertions seem, that her very legs are spread behind her tail to aid her flight. She approaches, however. The eagle has marked her for his prey. As the swan is passing the dreaded pair, the male bird starts from his perch, in full preparation for the chase, with an awful scream, that to the swan's ear, brings more terror than the report of the large

duck-gun. Now is the moment to witness the eagle s powers. He glides through the air like a falling star; and like a flash of lightning comes upon the timorous quarry; which now, in agony and despair, seeks, by various manœuvres, to allude the grasp of his cruel talons; she mounts, doubles, and willingly would plunge into the stream, were she not prevented by the eagle, which, long possessed of the knowledge, that by such a stratagem the swan might escape him, forces her to remain in the air, by attempting to strike her with his talons from beneath. The hope of escape is soon given up by the swan. She has already become much weakened, and her strength fails at the sight of the courage and swiftness of her antagonist. Her last gasp is about to escape; when the ferocious eagle strikes with his talons the under side of her wing, and, with resistless power, forces the bird to fall in a slanting direction upon the nearest shore. It is then, reader, that you may see the cruel spirit of this dreaded enemy of the feathered race, while, exulting over his prey, he for the first time breathes at ease. He presses down his powerful feet, and drives his sharp claws deeper than ever into the heart of the dying swan. He shrieks with delight as he feels the last convulsions of his prey, which has now sunk under his unceasing efforts to render death as painfully felt as it can possibly be.* The female has watched every movement of her mate, and if she did not assist him in capturing the swan, it was not from want of will, but merely because she felt full assurance that the power and courage of her lord were quite sufficient for the deed. She now sails to the spot, where he eagerly awaits her, and, when she has arrived, they together turn the breast of the luckless swan upwards, and gorge themselves with gore.'

Wilson is not less happy in his description of the manner

* We may be allowed to doubt the truth of the expression in the last clause of this sentence, which seems inserted for effect. So far from the victim being subjected to unnecessary torture, there is a remarkable instinct given to animals of prey, by which they know how to dispatch their quarry with as little pain as possible, and this they in general practically effect.

in which the white-headed eagle obtains a repast of fish. He avails himself generally, it seems, of the labours of others, and especially of the osprey, or fish-hawk, which he forces to deliver up his prey. After describing the variety of the feathered tribes within the view of the eagle, as he sits 'elevated on the high dead limb of some gigantic tree,' the naturalist thus proceeds:—'High over all these hovers one whose action instantly arrests his attention. By his wide curvature of wing, and sudden suspension in the air, he knows him to be the fish-hawk, settling over some devoted victim of the deep. His eye kindles at the sight, and balancing himself with half-open wings on the branch, he watches the result. Down, rapid as an arrow, from heaven descends the object of his attention, the roar of its wings reaching the ear, as it disappears in the deep, making the surges foam around. At this moment the eager looks of the eagle are all ardour; and levelling his neck for flight, he sees the fish-hawk once more emerge struggling with his prey, and mounting in the air with screams of exultation. These are the signals for our hero, who, launching into the air, instantly gives chase, and soon gains on the fish-hawk. Each exerts his utmost to mount above the other, displaying in these rencounters the most elegant and sublime aerial evolutions. The unencumbered eagle rapidly advances, and is just on the point of reaching his opponent, when, with a sudden scream, probably of despair and honest execration, the latter drops his fish. The eagle, poising himself for a moment, as if to take more certain aim, descends like a whirlwind, snatches it in its grasp ere it reaches the water, and bears his ill-gotten booty silently away to the woods.

NINTH WEEK—SATURDAY.

PREDACEOUS ANIMALS.—THEIR OFFICES IN NATURE.

I HAVE already more than once adverted to the remarkable, and, in some respects, mysterious arrangement, by which cer-

tain animals are formed, to deprive other living creatures of their existence, and gorge themselves with their remains.* This is a subject, however, which, in reference to the moral character of the Creator, is of very grave importance, and requires deliberate consideration. The predaceous habits of the eagle tribe, which we have just been contemplating, furnish a proper opportunity for the discussion. I do not doubt that the system of prey can be shown to be a benevolent provision, suited with consummate wisdom to the other conditions of our fallen world.

In arguing this subject, it is especially necessary to keep in mind what was said in the commencement of the 'Winter,' volume, regarding the character impressed on Nature, which does not exhibit a system such as might be formed by a philosopher in his closet, where evil is excluded, and moral perfection and unalloyed happiness universally prevails; but a scheme of compensations and contrivances, by which 'evils are averted or mitiga ed, and excellence is drawn from the very bosom of apparent defect and worthlessness.'† This is just what we might expect to discover in a world of discipline, for such a rational but sinful creature as man. It is what, in every part of our inquiry, we have found actually to exist.

The first question connected with the subject I am now discussing, is the general one of the existence of pain. With Sir Charles Bell's admirable exposition of the sensibility of the surface, compared with the deeper parts of the body, the reader is already acquainted;‡ and nothing farther is necessary to show in this instance, that pain, so far from being an unmitigated evil, is given for benevolent purposes, is obviously modified and limited so as best to promote these purposes, and in the advantages which it confers, unspeakably counter-balances any distress which it may occasion But this is only an example, though a striking one, of a principle which every

* See particularly 'Winter,'—paper on the Balance preser ed in the Animal and Vegetable Creation.

† See 'Winter,'—papers on the Characters impressed on Nature.

‡ 'Winter,'—paper on Contrivance.

where discovers itself to the judicious inquirer, and forms a peculiar characteristic of the providential arrangements in the animal world.

There is another view of this subject, which has not been considered with the attention it demands, but which would amply repay the inquirer into Nature, I mean the comparative degree of sensibility to pain existing in different orders of beings. Dr. Macculloch has turned his mind to this subject, and has brought forward many convincing reasons to show that we are mistaken if we judge of the pain suffered by the inferior creation, from the acuteness of our own corporeal feelings;—that, in fact, the sensibilities of all the lower animals seem to be inferior to that of man, while they exist in very different degrees in different orders; and that these sensibilities have been so regulated as 'to permit them to perform their functions, and enjoy their lives, with the least superfluous pain, or contingency of pain.'

This is an important point obtained, in commencing the consideration of the system of prey; for if it can be shown that this system secures a far greater extent and variety of animal existence, than on any other conceivable plan, consistent with other cosmical arrangements, was at all possible, and at the same time that the enjoyment of life greatly countervails the suffering, the scheme will at once appear to the benevolent; while the obtuseness of feeling in those animals which suffer a violent death under this system, serves still further to abate the evils with which it is confessedly attended.

The power of subsistence in animals depends on the quantity of their food. The design of the Creator, therefore, being to extend happiness by extending animal life, one necessary part of this intention must be to produce the greatest possible quantity of food. Now, although it be true, that the primary means of subsistence are placed in the vegetable world; yet, if animals were merely constituted so as to consume plants and their produce, it cannot be doubted, not only that the various tribes of animals would be greatly diminished, but that the entire mass of life would be very much reduced, and many

portions of nature would remain untenanted. If we look at the ocean, for example, this will appear in a very striking light. Vegetable productions could not, consistently with known material laws, have been produced in the sea, in sufficient quantity to supply marine animals with food, to the extent in which they actually exist. Let any person reflect on the number of fishes, 'the myriads of shell-fishes, the still more uncountable myriads of the inferior tribes, down to the coral-making animals, and even, beyond all this, the incomprehensible crowds, which, in a constant series of gradations downwards, both in structure and magnitude, at length escape our microscopes,' and he will easily perceive that, but for the predaceous habits of the inhabitants of that element, it would have been impossible that the same quantity of life could be sustained.

The very same thing, though in a more limited degree, takes place among land animals. Now, it is allowed, that a considerable accession of food might have been obtained by bestowing on all living creatures the instinct which actually belongs to those animals that, like the vulture, feed on carrion. But this supply is necessarily limited and uncertain, and, without an alteration in the laws of decomposition, would always be transitory. The system of prey was therefore necessary, under present conditions, for the fulfilment of the benevolent intentions of the Creator.

In adverting to this system, it has been justly said, that, as respects the animals which are the victims of it, a natural death is generally attended with greater, and certainly more protracted pain, than a violent one; and, the case of domestic animals, which are the prey of the human race, the care of man, in defending them from enemies and providing for them an abundance of wholesome and agreeable food, is a further countervailing circumstance of no slight amount. It does not appear, however, that Paley has taken the most correct view of the subject, when he asserts that the system of prey is the natural and necessary remedy for 'super-fecundity,' the converse of this proposition being more consistent with an en

larged and enlightened consideration of the subject, namely that one of the intentions of what he terms super-fecundity was to promote animal existence in all its various forms. 'If,' says Macculloch, 'the cod produces six millions of progeny at once, it is because this food is assigned to other fishes as their provision: For any other purposes it would be an unwise appointment (which cannot be admitted), since even one fish would fill the entire ocean in a few years: And if while the marine insects of the north are produced in endless millions, their devourer, the whale, produces but one in the same time, we must conclude that these crowds were destined for its food.'

The system of prey, then, is a wise provision, intended not merely to preserve the balance of nature, as formerly stated, but to preserve that balance at the full extent of animal existence. The evil of a violent death, even were it tenfold greater than it is, could not counterbalance this good; and that evil has many mitigations. Not to recur to what has already been said as to the sudden nature of this kind of death, and the dullness among the inferior animals in their sensibility to pain, it must be remembered, that they are little tormented with anticipations of this calamity, nor is it aggravated by any knowledge of the fatal event awaiting them, even when in the very act of expiring under the fangs of their devourer.

There is another fact relating to this subject, which must not be omitted, as it is a singular and beautiful provision of Providence, for mitigating the pain of destruction. In the neck, near the skull, there is a point where a wound of the spinal marrow produces instant death, apparently without suffering; and it is not a little remarkable, that such effect is confined to a single and constant point. Now this point, though perfectly defended from all ordinary injuries, is accessible to a certain degree of violence, when that violence is skilfully applied. Dr. Macculloch remarks, that the knowledge of this fact, which man has only discovered by experiment, has been given to all predatory animals from their birth;

and if this is a needful security to them for procuring their food, it is still more a merciful provision for the suffering animal. 'Every one knows,' says he, 'that this part of the spine is almost always the object of attack; while, if there are some animals which as instinctively seize on the carotid arteries, the design is of the same nature, and both equally confirm the present views.'

These considerations are, I think, sufficient to establish that there is both wise and benevolent contrivance in this system of prey; but I must not allow it to be thought that I have any wish to conceal the difficulties under which natural religion still labours, on the whole question, of which this is only a part. Let the mitigations be what they may, the question still remains behind, why evil should exist at all. It is obvious that this is intended; and yet we cannot conceive any reason which should render impossible the existence of a world without it. Such a world, indeed, would be entirely different from ours, both in its construction and in its ultimate object. It would not be a world of discipline. If we would understand the intentions of the Eternal, and fully vindicate his perfections, our knowledge must be derived from the higher science of revelation. It is there alone that we can understand why 'the whole creation groaneth and travaileth in pain together until now.'*

TENTH WEEK—SUNDAY.

CHRIST, THE JUDGE OF THE WORLD.

THERE is an important doctrine connected with our Lord's ascension, which was not noticed in considering this subject in a previous paper, and to which I shall now direct the reader's attention. I allude to the office which he is appointed to

* Romans viii. 22.

execute as the Judge of the human race at the Last Day. This doctrine is distinctly taught, both by Christ himself and by his apostles; and there is one passage in which it is spoken of in such a manner, as to throw a very pleasing light on the intention of this wonderful arrangement. It is said that God hath given his Son authority to execute judgment, 'because he is the Son of Man.'* There is in this a condescension to the condition and feelings of the human race, which, however astonishing, is yet in perfect harmony with the Divine character, as exhibited both in the works of creation and providence.

It is impossible to view the Eternal Creator of the universe without feelings of awe and terror. There is something so prodigiously grand and amazing in the idea of a Being infinitely perfect, who sustains all things by His own inherent energy, and who is at the same moment present throughout the immensity of His works, that the mind shrinks back with dread, and feels as if it were annihilated in his presence. Even when this self-existent Being condescends to appear in the most amiable and endearing light,—when He assumes the character of our father and friend, the imagination cannot altogether divest Him of the terrors of His majesty. We still see Him dwelling in light inaccessible and full of glory. We behold the angels veiling their faces in His presence, and the pillars of heaven trembling at His nod. Our confidence is lost in veneration, and our love is overpowered by fear; and the language of our hearts is, 'Lord, what is man that thou art mindful of him, or the son of man that thou visitest him?' When, to this feeling of inferiority, is added the remorse of a guilty conscience, we can no longer endure a sense of the Divine presence; our hearts sink within us, and we hide ourselves in the dust. This sentiment is emphatically expressed in the book of Job: 'Behold the heavens are not clean in his sight, and he charges his angels with folly. How much more abominable and filthy is man, who drinketh iniquity like water.'

* John v. 27.

It is this condition of fallen man, so insignificant, abject, and guilty, when compared with the infinite perfections of his Creator, which stamps such a peculiar value on the whole scheme of revealed religion, and which especially endears to the heart of the sinner that astonishing exhibition of mercy displayed in the atonement and intercession. Nor is there less ground of assurance in the light thrown on the Divine character and intentions by the appointment of the *Son of Man* to be the judge of the guilty race of Adam.

That our fate in a future world shall in some way be regulated by our conduct in this, is the dictate of natural as well as revealed religion. 'Whatsoever a man soweth that shall he also reap. He that soweth to his flesh, shall of the flesh reap corruption; but he that soweth to the spirit, shall of the spirit reap life everlasting.' But though this is a doctrine on which men are generally agreed, yet an important point remains still to be decided. What are the precise limits of our election or condemnation? At what particular step, in the progress of guilt, is the favour of the Righteous Governor withdrawn; and what degree of holiness, or what other qualification, is required for enjoying his approbation and blessing?

To determine this important question, reason is totally inadequate. The only discovery to which this feeble guide can lead us, is, that none of the creatures of God can demand an eternal reward as their right; that imperfect and guilty beings such as men, are at best unprofitable and unfaithful servants; and, instead of the favour, have rendered themselves liable to the displeasure, of a just and holy Judge.

Hopes of the Divine mercy, indeed, it is flattering to entertain; but, in the religion of nature, these are not founded on any rational conviction. They are only vague and unsatisfactory conjectures, which our consciences reject, and which can never form a proper ground of trust and confidence; or, shall I not rather say, they are altogether false and delusive. The discoveries of revelation, however, are more important and favourable. The Gospel directs us to 'the blood

of sprinkling, that speaketh better things than that of Abel. We are assured that Christ died 'the just for the unjust, that he might bring us unto God.' And thus that the mercy and justice of the Divine nature are reconciled, and the sinner who believes, and accepts the offered mercy, is placed in a state of grace.

But still a dark and impenetrable cloud hangs over the councils of the Almighty; the exact boundaries between the kingdom of God and the kingdom of Satan remain to mortal vision undefined; and the children of Zion tremble while they rejoice. In this state of uncertainty, it affords to the servant of Christ unspeakable relief to reflect, that his eternal doom is to be decided by his beloved Master; that the same Jesus, who on earth died for his sins, and now pleads his cause in heaven, is, at the last day, to sit in judgment on his soul, and to appoint his station in the world of spirits. When he reflects on his own worthlessness, indeed, he doubts and despairs. But when he turns his eye upon his Redeemer and Judge, his faith expands, and his hope revives, till at length, after many fears and many conflicts, all the consolations and encouragements of the Gospel come to cheer him in the path of duty. Every circumstance in the life of his eternal Judge which proves his love to man, is to him a ground of hope and comfort. 'He who came down from heaven to save a guilty world,' will the experienced Christian say, 'and submitted to the pain and ignominy of the cross, that he might give eternal life to his enemies, will not shut his ears to the cry of the broken in heart; he will not turn away with unbending severity, from the believing and penitent sinner who longs for his salvation, and strives to gain an interest in his love. The gentleness, the kindness, the meekness, and the patience of his nature, all encourage me to hope. Every tear which he shed over suffering humanity,—every sigh which escaped him for the prevalence of sin,—every pang he endured in accomplishing the salvation of man, is a new pledge of the interest he takes in my welfare. I will go to him with holy confidence; I will throw myself at the foot-

stool of his mercy,—or, rather, I will fall into the arms of his love. I shall find in my Judge a friend and a brother. With a smile of encouragement he will say to my soul, "Fear not, I am the First and the Last: I am he that liveth and was dead, and behold I live for evermore, and have the keys of hell and of death. Continue thou in my love; and because I live thou shalt live also. Thy transgression is forgiven, thy sin is covered. Come, thou blessed of my Father! inherit the kingdom prepared for thee from the foundation of the world."'

TENTH WEEK—MONDAY.

QUADRUPEDS.—THEIR CHARACTERISTICS.

The division of lower animals which in this paper and those immediately following, is to engage the reader's attention, is generally placed by naturalists highest in the scale of importance. The frame-work of the various species of quadrupeds, though this differs widely in different classes, makes the nearest approach to the perfection of the human body, and, in many of them, there are points in which that perfection is rivalled, and even exceeded. It is not difficult, indeed, to trace through every class of this extensive order, a similarity more or less striking to man; and, while in one the limbs are stronger, in another better adapted for agility, and in a third for swiftness, to point out in every species the bones, muscles and organs, which correspond to those of the human family. The ape, in all its varieties, presents, even to the eye of a child, a ludicrous caricature of the human form and features. But even in the dog, when at his master's command he erects himself upon his hinder legs, it is at once observed that there exists a striking resemblance in his general structure to his nobler fellow-creature. If we examine the parts of his body with minuteness, we shall find that the forelegs, which require no great stretch of fancy to convert them

into arms, are formed like our own, of several bones closely jointed together at their extremities, and each clothed with muscles adapted to its own purposes, capable of bending out or in, though less perfectly, still in a similar manner, but differing in this, that while the hand and arm of man are fitted to enable him to perform the functions of a rational being, the foreleg and paw of the dog are calculated for the humbler services of tearing his prey, and aiding his locomotion. If we turn our attention to his posterior extremities, we shall find the haunch, the thigh, the shank, the heel, and the foot of man, distinctly represented in those of the brute, though suited to the structure of the rest of the body to which they belong. This resemblance, though it is visible even in the birds and fishes, is in these classes comparatively faint and imperfect; and the nearer approach to perfection on the part of quadrupeds, which this similitude to the human family seems to indicate, is confirmed by other observations. It is true, that birds, possessing the advantage of wings, are more rapid in their journeys, and more discursive in their habits. They can leave the swiftest quadruped far behind, and need no ship to waft them beyond the sea; but their bodies are necessarily lighter, and their limbs less muscular, while the brain is smaller, and they are in general much inferior in sagacity. The eagle, the noblest of the birds, will not abide a comparison with the lion or the elephant.

In casting our eyes over the various species of quadrupeds, we see them placed in all latitudes, and intended for every conceivable mode of existence. One subsists on roots, another on leaves and herbage, a third on grain, and a fourth by preying on its weaker neighbours; and, as we might have expected, the structure and organs of each are beautifully adapted to the situations they occupy, and the mode of life they are intended to pursue. The more narrowly we inspect the faculties of these creatures, with reference to their circumstances, the more clearly will we perceive the truth of this assertion. Compare, for example, if it can be done without a smile, the structure of the mole with that of the cat,—the for-

mer dwelling in a subterranean apartment, habitually forcing its way through the earth, and stones, and gravel,—the latter subsisting on birds and mice, which it seizes by means of its teeth and claws, with an agility the most surprising. The mole, to facilitate the means of its existence, possesses a round body, clothed in a smooth coat of hair, soft as velvet, and so close, that the soil cannot penetrate it. Its snout is hard and cartilaginous, like that of the hog Its anterior extremities consist chiefly of feet, resembling the human hand, fixed to the sides, without the intervention of legs, and admirably suited to the purpose of removing the earth, as it pushes its way. Its eyes are made so small as hardly to be perceptible, in order that it may not be incommoded by the dust or the sand through which it passes; while the ears, which are peculiarly sensitive, are securely defended from every ordinary annoyance. The first appearance of the mole at once proclaims its entire unfitness for existing on the surface of the soil, and demonstrates that the Creator intended it to burrow under ground. The cat, on the other hand, gives direct and unquestionable proof of its superior destiny. The eye, active and suspicious, turns with rapidity from one point to another, in search of a victim, or in preparation for escape. The ear, pricked up as in the act of listening, gives instant notice of all that occurs immediately around it, and keeps the animal in readiness to spring upon its prey, or to fly from its pursuers, as circumstances may direct. The limbs, both posterior and anterior, are admirably suited to its natural disposition, being formed more for agility and sudden impulses, than for sustaining lengthened and persevering exertion. The hinder legs, composed of the usual number of bones and joints, every division of which is long in proportion, much inclined, and moved by muscles of great activity, afford all the advantage of a lengthened and rapid spring, without imposing the awkwardness of limbs stretching to an immoderate length from the body. The forelegs, clothed with flesh, which is more tendinous than muscular, and armed with claws of great sharpness and power, give the little animal a manifest supe-

riority in striking its victims, and defending itself against oppression.

The difference in structure, which is so easily perceived between the mole and the cat, is not less remarkable, though it may be less striking between the latter and its neighbours of the canine race. The cat is formed for very rapid, but not for long-sustained, movements. It leaps upon its prey. It climbs the nearest tree when flying from its enemy, or it skips about in graceful gyrations, when indulging in a mirthful mood; but its motions are all sudden, and soon over; and we have seen how its structure answers to its habits. The dog, on the other hand, depends mainly upon his perseverance. Having once perceived the scent of his prey, he seeks to overtake it, more by the constancy and ardour of a sustained pursuit, than by extreme speed of food. Accordingly, his limbs are formed rather for continued running, than for making a sudden spring. The hinder leg is less bent, because its parts are shorter in proportion to its height. The paws and forelegs are not so formidably armed; nor does he require that they should be so, for his prey is generally exhausted by its efforts to escape, before it is secured. His eye is less keen, but his sense of smell, on which he chiefly relies, is more acute. The hare and the rabbit escape from him by superior swiftness, and, when taken, it is because their powers of endurance, or their steadiness and perseverance, are inferior to his. Their structure is not less adapted to their necessities than his, and the struggle between the constancy of the one, and the speed of the other, is not more interesting to the sportsman, than instructive to others. There is no department of this wide field, in which there do not exist proofs, as beautiful as they are ample, of the adaptation of the animal creation to the posts appointed for them respectively in the economy of the world.

G. J. C. D.

TENTH WEEK—TUESDAY.

QUADRUPEDS.—THEIR BODILY ORGANS.

In this highest order of the inferior animal creation, the bodily organs are more fully developed than in the orders below them. This paper shall be devoted to a brief consideration of some of these organs, as modified in different species, so as to answer the peculiar ends to which the animals are respectively destined. With regard to birds, I have already noticed such variations in the different forms of their bills, and I shall therefore begin by examining the corresponding organ in quadrupeds.

The mouth, in this order, is formed on a different principle from that of birds. It is not intended to cut the air like that member in the winged tribes, nor like it to act as a hand, for the capture of prey; and therefore the peculiar conformation which constitutes a bill was not required. There were other specific ends which the habits and functions of beasts required in reference to their food; and the adaptations by which these ends have been effected, form of themselves a delightful and improving study. If we regard the teeth, the mechanical contrivances are so ingenious, and the variations so admirably adapted to the different kinds of food, and the habits and powers of each animal, that in these alone we might find a demonstration of a wise and benevolent Contriver. So true is this, that not only from the form and arrangement of the teeth in the jaw, but even from the construction of a single tooth, a skilful comparative anatomist can with certainty assign the food and mode of life of the animal, and various other particulars of its physiological character. In ruminating animals, for example, there is one kind of teeth,—in beasts of prey another,—in gnawers a third,—in animals who live on both flesh and vegetables a fourth. These varieties are constantly found combined with a difference of function. But not only so, every peculiarity of food and habit is consulted; and there

are, under each of these general heads, numerous subdivisions, the object of which can in most instances be distinctly traced.

If, from the teeth, we pass to the mouth itself, we discover the clearest evidence of premeditated intention. There is system within system, and variety within variety, all bearing a studied reference to the nature and instincts of the animal. Compare, for example, the mouth of the cow or the horse, with that of the wolf or fox: you see at once that the breadth in front of the one was constructed for grazing,—and the narrowness of the other, and its length of jaw, was intended to afford a powerful forceps for the detention or killing of its living prey. In the feline kind, the shortness is compensated by the greater length of the teeth, and by the talons. In the hog, the variation is even more striking; where the mouth, though it appears at first as obstructed by the protrusion of the nose, forms in reality a scoop, following in the track which the latter has ploughed for it, and thus seizing the roots which the snout has loosened or laid bare. These are specimens of peculiar arrangements, and they are only specimens. The adaptations are universal.

The feet of quadrupeds afford an example of adaptation scarcely less striking. The arrangements run through all the species, with a wisdom of contrivance which becomes the more apparent the more it is examined. Let the foot of an ox be compared, for instance, with that of a horse, in reference to their respective natures and destinations. The horse was intended for hard ground and rapid motions; and the hoof is constructed accordingly, answering its end perfectly in a state of nature, and well adapted for the defence which man has contrived for it under domestication. The place of the ox was on meadow lands, and on soft grassy plains; this also is provided for, in the divided and spreading hoof, and in the dew-claws. Compare these again with the goat, whose destination is to ascend rocky precipices, and to find a precarious footing on the steep declivities of the mountains, and with the sheep, which must make its narrow track along the sides of the hills,—and the adaptations in these instances also will

become apparent. Still further, the foot of the camel, which is a broad, elastic, and soft cushion, is perfectly suited to those sands which, as I have elsewhere remarked, every peculiarity of its construction shows to be its intended dwelling-place. The rabbit was intended to run, as well as to dig and burrow, —the mole only to dig and burrow; let the construction of each be examined with reference to this difference of design, and its wisdom will be manifest. The mouse and rat can walk without difficulty on surfaces not horizontal, by means of the sharpness of their claws, united to their great strength, and the lightness of their bodies. For the walrus, however, whose destination was also to climb, another provision was necessary, and this was found, not in mechanics, like the other provisions, but in an abstruse philosophical principle. This amphibious animal, equally ponderous and inactive, is compelled to clamber over inclined and smooth rocks, in quitting the sea; and this object is attained by enabling it to produce a vacuum in the sole of its foot, like that by which children amuse themselves in lifting great stones with a piece of moistened leather attached to a string. This remarkable contrivance is not confined to the walrus; it is not only found in numerous insects, as has already been mentioned, but in the gekko of India, where it is interesting to remark the different construction adopted in relation to its necessities. Each toe has transverse cavities, opening by slits below, which can be rendered vacuums by muscular action. By this means, it is enabled to run, with considerable speed, up the smooth walls of chunam, with which the houses of that country are usually covered.

Were we to examine the legs of quadrupeds, we should not be less struck with their admirable adaptations,—some being formed for speed, others for climbing, others for leaping on their prey or seizing it, and others again for strength to sustain an enormous body, such as those of the elephant; but the field which this opens is much too extensive to be at present entered upon; and I shall conclude this branch

of inquiry, by a short reference to the hair of this order of animals.

It has already been shown, how admirably the feathers of the winged tribes suit their peculiar functions as tenants of the air. The hair of quadrupeds is a covering of a different kind, adapted to their peculiar situation in the plan of existence. In hair, the great variations consist in quality, length and density; while different qualities, such as hair and fur, are sometimes united. The general purpose is warmth; and the chief proof of intention in the variations, lies in the modifications to adapt this covering to different climates. I have already noticed this subject with reference to winter;* and I shall merely desire the reader here, to attend to the non-conducting and non-radiating properties of this covering, its annual renewals, its variations in quantity, or density, or quality, according to the variations of temperature, and its occasional power of changing colour, so as to adapt itself to that of the ground, or to some alteration of climate.

In all these particulars, and a hundred others which might be named, the structure and condition of quadrupeds, clearly exhibit such benevolent design, such a minuteness of attention to their circumstances and wants, as to furnish new and most interesting proofs of an unceasing and universal exercise of the Divine perfections in the works of creation.

TENTH WEEK—WEDNESDAY.

QUADRUPEDS.—THE BAT.

In ascending from birds to quadrupeds, we meet with a family of animals which seems intended to form the connecting link between the two orders, thus completing the chain of animated nature in this, as we have seen to be the case in other transitions. This family is that of the bat.

It is not one of the least remarkable proofs of the wisdom

* 'Winter,'—Tenth Week, Wednesday.

of the Creator, that each object or being in nature has been so perfectly fitted for its end, and the station it occupies, that those which, on the first view, are thought mis-shapen or disgusting, become, on closer investigation, the sources of pleasurable and instructive contemplation. Each part is found so well adapted to its use, that the changes which might appear to the superficial observer conducive to elegance or beauty, would but hinder the design, and produce confusion, where all is order and harmony. Of this the apparently ungainly form of the bat is an exemplification. Daubenton thus describes its structure:—'The elbow is found near the knee; the fore-arm is very long, and obliquely extended from above downwards, and from behind forwards, as far as the nose of the animal. The wrist is placed against the ground, and there is but one finger on the anterior extremity, which is the thumb. The knee is raised as high as the lower part of the rump, and the five toes of the hind feet are of equal length, and turned outwards. The arm is extended horizontally, from the front to the back part, and the thigh vertically, from above downwards; the arm is concealed behind the fore-arm, and the thigh behind the leg; they are, moreover, enveloped in the membranes which conceal the tail, and all the hinder parts of the body. Besides the thumb seen on the anterior extremities, there are four very long fingers, extending from the fore-arm, enveloped in the membrane, and folded, near the elbow, by their extremity.'

While on the ground, these long extremities are of little use to it, and it stands propped on the breast, appearing one of the most helpless and awkward quadrupeds in existence. To move along, many different and very fatiguing actions are required. Its pace is heavy and dragged, and it runs in a grotesque and ungraceful manner. The ears are often very large, and, together with the whole membranous surface, are quite naked; the eyes are small, and too weak to endure the light of the sun: and the wide mouth, reaching from ear to ear, completes the uninviting picture. Were we to look no further, we might deem that the skill which lives through all

creation, had been withheld from this feeble and imperfect animal. But when, gaining the aid of some slight eminence, it raises its fore-legs, unwraps from about them the numerous folds of its velvet wings, and darts away with tremulous but rapid flight, we see that it is not dependant for change of place, on the motion that has excited our pity; and, on pursuing the investigation, we find that every part of its structure has been so contrived, by a wisdom far above ours, as to make its existence easy and pleasant. Though the arms of the bat are much elongated, the bones of the fingers exceed their whole length. Over these is stretched the leather-like membrane, which constitutes the wing; it is only a prolongation of the skin, the back and belly each furnishing a layer, and yet it appears but a delicate and transparent net-work. Were the membranes, or bones which support it, compact and thick, their weight would disable the bat from using them; but, becoming thinner as they recede from the centre of motion, they are the instruments of its high and unimpeded flight. The pectoral muscles, which move the wings, are strong, and the breast-bone projects, that these may have an ample space for fixing upon. By means of this construction, the bat is enabled to fly very swiftly. It is gradually aroused from the torpor of winter, at the approach of a milder season, and, slowly recovering the power of motion in the dark recesses of its cave, at length goes forth in search of the insects which have been called into life and activity by the returning power of the sun. It readily discerns its prey, even at some distance, and darts at it, ascending at times, in the chase, to a considerable height, though, in general, it finds a more abundant supply while hovering near the ground, or skimming the surface of water. Here the softness of its wings is of essential service as they swiftly cut the air, without making any sound to warn the insect into flight or concealment. Though in damp weather the bat can remain for days without food, and even sink again into torpor, his appetite is voracious, and he clears the air of swarms of insects, which, if not exposed to that and similar destructive agents, would multiply so fast as to encum-

ber it, and render it unwholesome. The small eyes of the bat are less liable to injury than they would be if larger or more protuberant; and they are not made to bear the glare of day, as its season of activity is during the obscurity of twilight, when alone it can obtain food. As if conscious of this, its exertions are, during that period, unremitting, and often continue till the night is far advanced. Notwithstanding its faint power of vision, and even when totally deprived of it, the bat pilots itself through the air with the greatest skill, avoiding every impediment, though no larger than a twig, and accurately seizing its minutest prey.* This is imputed by some naturalists to its acute perception of sounds, and by others to the delicacy of its nerves; but Cuvier, more philosophically, refers it to the sense of touch resident in the membranous skin of the wings, affected by the reaction of the air in a near approach to any object. Here again we must admire the wisdom that launched this little being on its airy way; for, had this skin been covered by the reddish fur which clothes the rest of the body, that keen sensibility would have been destroyed, and the bat must have darted recklessly along, always in danger of being stunned or wounded by striking against objects which it could not discern, and snatching at random, and in vain, for food, till, spent and weakened, it met a painful death. The large and powerful mouth, and sharp teeth of the bat, enable it to put its victims out of pain instantaneously, and by one gripe. While stationary, it frequently fixes itself, by the hook of its hind feet, on some projection, and hangs securely, with the head downward, and the wings folded on the breast. This inverted position is most

* Various experiments have, at different times, been tried, in order to ascertain how far, and under what circumstances, the peculiar faculty or sense, which supplies the place of sight, is called into operation; and it has been found that, though the eyes be sealed up, or even removed entirely, and the animal let loose in a room, with a thousand intricacies and objects, it will pursue its abruptly wheeling flight as usual, threading every labyrinth, avoiding every obstacle, and all this with the same ease, quickness, and precision, as would have been the case had the sight been ever so perfect.

curiously adapted to its wants, and compensates for the difficulty it has in rising from a flat surface; for, by merely loosening its hold from the rock or tree, the creature is at once in the air, on unrestrained and buoyant wing.

The species of British bats have been computed by naturalists to amount to fifteen or sixteen, but if we take into account those that are to be found in foreign countries, we cannot estimate the whole as fewer than two hundred. Some of these are very large, compared with the kinds we are acquainted with. The kalong, for example, a species described by Mr. Horsfield, which is very abundant in the lower districts of Java, is said to be fully five feet in the extent of its expanded wings, and one foot in the length of its body. This is a fruit-eating kind, and is generally found in companies of several hundreds, fixing on a tree for their roosting-place, where, suspended in rows or clusters, by their hinder claws, with their heads hanging downwards, and their wings folded round them, they exhibit a singular spectacle. During the day they are in general silent, though, if disturbed, they utter 'sharp piercing shrieks.' Soon after sunset, they leave their roosting-place, and begin their nightly search for food.

The vampire, of which such dreadful stories have been told, is of the same tribe. It is a blood-sucking species, and has been said, while banqueting on the blood of its victim, to fan him with its wings, so as to lull him into a profound sleep, from which he never awakes. This is an entire exaggeration. Don Felix d'Azzara, an accurate observer, who had personal experience of their power, says, 'The wounds which they inflicted, without my feeling them at the time, were circular, and rather eliptical; their diameter was trifling, and their depth so superficial as scarcely to penetrate the cutis. It was easy, also, on examination, to perceive that these wounds were made by suction, and not by puncture, as might have been supposed. On so trifling a basis are the airy visions of superstitious terror found frequently to be erected, when subjected to calm philosophical inquiry.'

These facts require no comment. Small and uncomely as is the bat, consecrated of old to gloom and Proserpine, there is a multitude of nice adjustments in the mechanism of its frame, and the omission of but one of these would have destroyed the efficiency of all the rest. But nothing is wanting, nothing is out of place. Each part of the structure is in perfect accordance with every other, and all combine to adapt the animal to its position in the scale of creation. We admire the gorgeous butterfly, borne past us on the breeze of summer; our eyes pursue the ascending lark, till he is lost in the glories of morning; but Almighty skill is not more apparent in the rich penciling of the butterfly's wing, than in the soft transparency of the bat's; nor is Almighty goodness less evident in forming the bright eye of the lark to greet the rise of day, than in consigning the darksome bat to the grey shades of evening. The more eagerly we cast the eye of intelligent inquiry on the meanest and lowest objects in nature, the more clear will be our perception, increasing at every stage of our progress, of the depths of that unfathomable Wisdom which

> 'Sees all, as if that all were one,
> Loves one, as if that one were all.'

M. L. D.

TENTH WEEK—THURSDAY.

QUADRUPEDS.—THE MOUSE.

The harvest-mouse is the smallest of quadrupeds, two being only equal to the weight of a half-penny. The delicate formation of its slender limbs might make it appear incapable of doing either good or evil to mankind; yet so great are its numbers, that large quantities of grain are devoured by it; and the labourer sees the produce of his fields, nourished by the early rains, and matured by the autumnal sunshine, fall a sacrifice to these insignificant depredators. Few things are more deserving of admiration than the beautifully constructed

nest of the harvest-mouse. Suspended on a bean or th or a few stalks of wheat, it waves securely in every pas ing breeze. It usually contains eight young ones, which, being blind, naked, and helpless, would be much injured, if not destroyed, by a fall, and to prevent this, the aperture is closed by the parent with so much skill, that it is difficult, even on a near examination, to discover it. This aerial dwelling is round or oval, and formed of the plaited blades of grass or wheat; and the mouse climbs the perpendicular ascent to visit her young by means of a prehensile tail, with which she seizes and clings around it. These creatures are brought home in great numbers in the wheat-crop, or found in shallow burrows beneath the bean ricks. In winter they congregate for warmth in hollows, lined with grass and other soft materials, and subsist on the food they have providentially laid up in the season of abundance. Thus are they guided on from infancy to maturity, and enabled to meet the demands of their brief existence, by the gracious Being, who never bestowed it on any, without imparting to them the means of making it safe and pleasant.

The meadow-mouse is another very small species of this animal. It chooses its abode in grass-fields, making numerous and widely-branching burrows along the sides of drains, or the embankments thrown up to prevent the rising of streams. Here these active miners incessantly ply their labours, till, by their long and united efforts, assisted by the action of the water on the cavities they form, the hollowed bank sometimes falls in, and the stream flows unchecked over the wrecks of human toil and ingenuity. Their warm and compact nests resemble those of the smaller birds, and are placed upon the ground, in the shelter of the grass, of which also they are made. In mild weather, they remain above ground, and their well-trodden lanes may be tracked in many directions among the long grass. They multiply very rapidly, but are kept down by the attacks of many foes, and afford a large supply of food to the owl of the twilight, and the quick-eyed hawk.

But the waving corn-field and the luxuriant meadow are

not the scenes most congenial to all the branches of this numerous race. The desolate marsh affords its favourite shelter to the marsh-campagnol; and it sports among the mud, or stationing itself on the reeds, patiently waits till the waters subside. Its prevailing hues are dingy brown and grey; and when in a state of repose, it more resembles a piece of its native mud, than a brisk and lively creature, possessing the powers of swimming, diving, and running, and making active exertions for the supply of its wants.

Nor are the deep recesses of the forest without their proportion of this extensive family; for the wood-mouse spends its summer months among them, and when chilled by the cold of approaching winter, seeks a warm, though not a more secure retreat in the habitations of men. It pierces itself a cell in the trees; and not even the hardest timber can withstand the incision of its strong teeth.

The jumping mouse of Canada closely resembles the common mouse; but its hind legs are very long, and enable it to move in the same way with the kangaroo. When pursued, it darts forward, and clears five or six feet of ground at every leap, and in this way it can advance with great swiftness for some time, resembling a flying bird, as it lightly poises its small frame in the air. It has also the power of running at pleasure. It feeds on the produce of the fields, and during the winter remains torpid, sometimes penetrating to the depth of twenty inches below ground, and snugly coiling itself up in a ball of clay.

The common-mouse, so remarkable for its swiftness and vigilance, is about three and a half inches in length. Though it is generally viewed with prejudice and dislike, He who assigned to it its form, and its place in the scale of creation, has not disdained to impart to it a great deal of grace and beauty. Its ears are of a very delicate texture; its eyes are large, brilliant, and intelligent; and its long whiskers are in frequent motion. When it goes forth in search of food, or frolics about in the fulness of enjoyment among its associates, it is a picture of animation and elegance. But its extreme

watchfulness and timidity, which constitute its chief protection, make it difficult to observe it to advantage; for man, in days of innocence, the guardian of the bestial tribes, is now the object of instinctive terror to those defenceless creatures, whose only resource in time of danger is a speedy flight.

The effect of fear upon the appearance of the mouse is thus described by an amiable naturalist:—'One of my boys caught a mouse in school a few days ago, and directly marched up to me with his prisoner. I set about drawing it the same evening; and all the while the pantings of its little heart showed it to be in the most extreme agonies of fear. I had intended to kill it, in order to fix it in the claws of a stuffed owl; but happening to spill a few drops of water near where it was tied, it lapped it up with such eagerness, and looked in my face with such an eye of supplicating terror, as perfectly overcame me. I immediately untied it, and restored it to life and liberty. The agonies of a prisoner at the stake, while the fire and instruments are preparing, could not be more severe than the sufferings of that poor mouse: and insignificant as the object was, I felt at that moment the sweet sensations which mercy leaves in the mind when she triumphs over cruelty.'

The economic compagnol is another branch of this family, inhabiting Kamchatska and several parts of Siberia, well deserving attention, both for the skill with which it makes its burrow, and for its remarkable migratory habits. For what reason its migrations are undertaken, does not appear to be distinctly known, but the instinct seems to be of a very energetic nature. 'In the spring,' says Dr. Grieve, 'they assemble in amazing numbers, and proceed in a direct course westward, swimming with the utmost intrepidity over rivers, lakes, and even arms of the sea. Many are drowned, and many are destroyed by waterfowl or rapacious fish.' 'About the middle of July, they generally reach the rivers Ochetska and Judome, a distance of about a thousand miles.' The manner in which they cross the rivers of Iceland, of which they are also natives, is thus described by Mr. Olafson:—'The party

consisting of from eight to ten, select a flat piece of cow-dung on which they place the berries they have collected, in a heap on the middle. Then, with their united force, drawing it to the water's edge, they launch it and embark, placing themselves round the heap, with their heads joined over it, and their backs to the water, their tails pendant in the stream, serving the purpose of rudders.' If it were not that there is nothing too wonderful for the instinct breathed into the inferior animals, by the inspiration of the Creator himself, this account might be rejected as fabulous. Mr. Pennant defends its credibility from the known instincts of beavers and squirrels; and Mr. Henderson, who made it his business to inquire into the truth of the statement, considers it to be 'now established as an important fact of natural history,' having had it confirmed to himself by the testimony of two eye-witnesses of unquestionable veracity, whom he names. He adds further, what certainly increases our surprise, that they are said to 'make use of dried mushrooms as sacks, in which they convey their provisions to the river, and thence to their homes.'*

M. L. D.

TENTH WEEK—FRIDAY.

RUMINATING QUADRUPEDS.—THE GOAT AND SHEEP.

To describe even a few of the most remarkable quadrupeds, which the Creator has spread over the face of the earth, though in this exercise we should certainly find every where new cause of devout admiration and gratitude, would occupy too much space in a work which comprehends in its range such a variety of subjects. I find it necessary, therefore, now to limit my attention to those animals which have been domesticated for the use of the human race. Among these, several highly important varieties belong to the class of ruminating animals. Of this class, all are valuable to man, as supplying

* Henderson's Iceland, vol. ii. p. 186, 187.

him with food; from many he derives his clothing; others labour for him, as beasts of burden; their flesh, their hides, their horns, their hoofs, are all useful; and those which he has taken more exclusively under his protection, repay him a thousand-fold for the care they require at his hands. With this order the prosperity of the human family is intimately connected;—peaceful tenants of the earth, they add, by their presence, fresh and more cheering beauties to vale, and lawn, and mountain, and impart life and spirit to the scenery of nature. The sheep and goat, the ox and the camel, form a portion of the national wealth of every kingdom where they are domesticated, and conduce essentially to the comforts and conveniences of life, and to the progress of arts and civilization.

The whole species of the ruminating order are intimately connected in their physiological character and properties; insomuch that the gradations of their forms preserve an uninterrupted correspondence, even in those cases where we cannot account for their relations. 'He who observes only the print of a cloven foot,' says Cuvier, 'may conclude that the animal who left this impression ruminates; and this conclusion is quite as certain as any other in physics, or in moral philosophy.'* This is but an example of the mysterious harmony which the Creator has imposed on Nature.

Every one understands what is meant by ruminating, or chewing the cud; and I shall merely state, that animals of this description, which are all herbivorous, have their stomach divided generally into four, and always at least into three, distinct cavities or chambers, the first of which serves as a

* It may at first sight appear that the hog is an exception to this rule, so peremptorily laid down by Cuvier; but although this animal is in a certain degree cloven-hoofed, he differs in the conformation of his feet very materially from other animals which are marked with this peculiarity. He appears, indeed, to have only two toes, but he has actually four concealed within, and the other bones of the foot have no resemblance to those of cloven-footed animals.—'All that can be said,' observes Buffon, 'is, that in some respects he forms the link between the whole and cloven-footed animals, and in others between the cloven-footed and digitated animals.'

receptacle to the grass or herbage, coarsely ground by the first mastication; and in the second of which, the mass, entering by degrees, is compressed, divided, and compacted into small balls, which are returned, by a voluntary action, into the mouth, to undergo the second process of mastication. During this operation, the animal reposes at ease, until the food it has taken has been all subjected to the like process. As soon as the ball is re-ground, it is swallowed directly into the third and fourth chambers, where it undergoes the digestive process.

Having already described the camel, I pass on to the goat and sheep tribes, whose families are so nearly allied in structure, that naturalists have been exceedingly puzzled so to define them as to mark the specific difference, and have at last been under the necessity of fixing on two very unimportant appendages as their ground of distinction,—those of the horns and beard. The goat is marked by the possession of a beard, and some radical difference in the *tornure* of the horns. There is also a slight variation in the line of profile, that of the sheep being more convex than the profile of its congener. In other respects, the two species run so much into each other, in different varieties, so to preclude the possibility of fixing on any permanent and well defined distinction. In Scripture, the same word is used to designate the young of both species, and lambs of the sheep or of the goats were generally employed indiscriminately in their sacrifices.

There are various allied families of the goat kind included under the general title of Antelope, of which the chamois of the Alps is one of the most remarkable, and the only species that is a native of Western Europe. The wild goat or *paseng*, is found in herds in the great mountain chains of Asia, where it bounds wild and free. Its size is superior to our domestic breed, but in all essential characters it is the same.

The domestic goat offers, like all thoroughly reclaimed animals, over which man has held a long-continued influence an almost endless number of varieties, in respect to its size, its colour, and the quality of its hair. The goats of Angora and

Cappadocia have long been celebrated for their soft and silky hair, forming the staple of the cloth called camlet. In Thibet there is a breed furnished with an undercoat of wool, of exquisite fineness and delicacy. It is from this that the highly valued Cashmere shawls are fabricated. Upper Egypt, on the other hand, has a race with close smooth hair, a convex forehead, and a projecting lower jaw. This is supposed to be the species so frequently alluded to in Scripture. It is still abundant in Syria, where it is kept, as in early times, in flocks.

From the goats, let us turn to the more important order of the sheep; and here too we shall find varieties too numerous to be detailed, and to the number of which the skill of the cultivator is constantly adding. In every age, the sheep has been among the most valued of man's possessions. It is the first reclaimed animal of which we have any account, and seems to have been taken into the protection of man immediately after the fall; for we find Abel mentioned as a 'keeper of sheep.'

In every country, the sheep offers peculiar modifications of character, produced, doubtless, by a combination of circumstances. Among our European breeds, none are more celebrated for their wool than the Merino sheep of Spain, which have been transferred to Britain and other European countries, and to New South Wales, which latter region is peculiarly favourable to the rearing of its valuable produce. In hotter climates, the fleece gives way to hair, and loses its form of wool. Among the singular varieties of this animal, I may mention that of Russia, which is distinguished by a long trailing tail; of India and Guinea, which to an elongated tail adds long pendant ears, short and smooth hair, a marked convexity of forehead, without horns, and long and slender limbs; that of Persia, Tartary, and China, which has a tail transformed into an enormous double globe of fat; and, lastly, that of Syria and Barbary, whose tail is of considerable length, consisting of a mass of fat, so great, that it is often necessary to support it artificially.

But the chief excellence of the sheep consists in the quality of its wool There is none of the domestic animals of so much value, both in a national point of view, and as regards the purposes of agriculture. They can be reared in situations and on soils where other domestic animals could not be supported; and, in general, they afford greater profit than is derived from the feeding of cattle. The annual fleece which they yield, while it gives a considerable return to the farmer, is of immense importance to our manufactures, and is indeed the staple commodity of the island.

The sheep, from its long domestication, has certainly lost much of its native sagacity, and may be said to be, comparatively speaking, a stupid animal. It throws itself entirely and confidingly on the protection of man, and ceases in ordinary cases, to think or act for itself. Yet some of its instincts it continues to retain, and nothing can be more interesting than the tender regard it displays towards its young. 'He who, in shearing time,' says Captain Brown, 'when the lambs are put up separately from the ewes, witnesses the correct knowledge they have of each other's voices; the particular bleating of the mother just escaped from the shears, and the responsive call of the lamb, skipping at the same moment to meet her; its startled attitude at the first sight of her altered appearance; and the re-assured gambol at her repeated voice and well known smell;—he who observes them at these moments, will not refuse them as great a share of intelligence as their ancient subjugation, extreme delicacy, and consequent habitual dependance on man, will allow.'*

The lamb has always been held as the emblem of innocence. In the christian system it is more. It is employed throughout Scripture as a type of him who was 'holy, harmless, undefiled, and separate from sinners.' There is no figure under which the Saviour is more frequently represented, and none employed in so many forms. It was used, under the Old Testament dispensation, in the typical sacrifices of the Israelites. In the morning and evening oblations, in their

* Goldsmith's 'Animated Nature,' vol. ii. p. 5, note.

expiatory offerings, and in the sacrament of the Passover, lambs were sacrificed, to represent that 'one sacrifice for sins,' which Christ offered up, before he 'for ever sat down at the right hand of God.' Hence he is spoken of as the 'Lamb of God who taketh away the sin of the world;' 'the Lamb slain from the foundation of the world;' 'our Passover which was sacrificed for us;' and his blood shed on the cross is called 'the blood of sprinkling, which speaketh better things than that of Abel.' A thousand beautiful allusions to the pastoral life, of a different kind, occur in the Inspired Volume, which throw a kind of sacred halo round that earliest of all professions. The pious mind irresistibly forms an association between the office of a shepherd and that of the 'good Shepherd who laid down his life for the sheep.'

TENTH WEEK—SATURDAY.

SHEEP-SHEARING.

One of the most laborious operations of those who rear sheep, and that in which all the members of a large family may find employment, is the shearing of their fleeces. The adoption of the proper season for that purpose is of great importance, as the quality of the wool in a considerable degree depends on it. The wool must be full grown, otherwise it is weak, and scarcely admits of being spun; and if the time of cutting be too long protracted, it becomes yellow, felted, and imperfect. There never can be any difficulty in ascertaining the proper time for this operation, as Nature points it out, the separation of the old wool from the new being distinctly marked.

In the less advanced stages of society, there are seasons attended frequently with some degree of pomp and ceremony, in which people, by common consent, meet together for purposes of festivity and social enjoyment. The mind seems to court such a stimulus, and this propensity is probably one of

the means by which the human powers are expanded, and the progress of society is advanced. The principal seasons of agricultural festivity are sheep-shearing and harvest-home.

In almost all pastoral countries, a sheep-shearing festival has in every period been customary; differing, however, in the mode of its celebration, according to the particular genius of the age, and the people among whom it was kept. The mind expands when it is overflowing with a sense of prosperity; and in times of simple manners, there is a generous sentiment excited by the bounties of Providence, which induces their possessors to share them with others. This sympathetic feeling passes through whole communities, and hence the origin of such customs as that now under consideration.

These feasts, like all other great occasions of rejoicing, doubtless partook originally of a religious character; and the practice was not unsanctioned by revelation. Under the Mosaic dispensation, the Israelites had their religious feasts of the first-fruits and ingathering, which were obvious adaptations to this natural tendency. Sheep-shearing festivals, in particular, were very early introduced. Some intimations of the importance of the ceremonial attached to such occasions, are afforded as far back as the time of the Patriarchs; and there seems to be a hint of its religious character, contained in the information that Laban first became aware that his daughter Rachel had carried off his images when he 'went to shear his sheep.' Further notice of this festival, with some particulars of its nature, as practised among the children of Israel, is given in the life of David. We are told that Nabal, at his sheep-shearing, 'held a feast in his house like the feast of a king;' and it should seem that on such occasions it was customary to send presents to friends and neighbours, and especially to those from whom obligations had been received. This supposition, at least, accounts for the message of David o that churl. It was 'a good day,' and he had reason to expect that his men, who had guarded the flocks, would be included among those who shared the bounty of the season.

In England this custom very early prevailed. It was a

time of merry-making. The maidens, in their best attire, waited on the shearers, to receive and roll up the fleeces. A feast was made, and a king and queen elected; or else this honour was conferred somewhat in the manner in which Darius is said to have been elected king of the Medes;—not, indeed, by the neighing of a horse, but by the fortunate production of the earliest lamb. In Drayton's Polyolbion, this simple rural festival, as it existed among our forefathers, is thus described:—

'The shepherd king,
Whose flock has chanced that year the earliest lamb to bring,
In his gay baldric sits, at his low grassy board,
With flawns, curds, clouted cream, and country dainties stored;
And, while the bagpipes play, each lusty jocund swain,
Quaffs syllabubs in cans, to all upon the plain;
And to their country girls, whose nosegays they do wear,
Some roundelays do sing;—the rest the burden bear.'

Thomson describes the same scene, if not with more truth, at least with more dignity and grace.

'At last of snowy white, the gathered flocks
Are in the wattled pen innumerous press'd,
Head above head; and, ranged in lusty rows,
The shepherds sit, and whet the sounding shears.
The housewife waits to roll her fleecy stores,
With all her gay dressed maids attending round,
One chief, in gracious dignity enthroned,
Shines o'er the rest, the pastoral queen, and rays
Her smiles, sweet-beaming on her shepherd king.
A simple scene! Yet hence Britannia sees
Her solid grandeur rise; hence she commands
The exalted stores of every brighter clime,
The treasures of the sun without his rage.'

What tends to render this simple festival peculiarly interesting, even to a refined mind, is not merely the sentiment which the poet so beautifully notices, that to her wool Britain is indebted for much of her superiority over other nations, in manufacturing industry and wealth; but also the feelings derived from the delightful season of the year with which it is associated. It is in June, the loveliest month of the year, that

in Britain the employment of sheep-shearing is chiefly carried on. This is the season of gay flowers, of sweet scents, of verdant lawns, and of leafy forests.

'Nunc frondent sylvæ, nunc formosissimus annus.'

Let him whom business has pent up in a large city, now find his way into the country, and he will feel the bounties of Nature breathing around him, and shedding their delights over his inmost soul. As he walks along by the bank of some woodland stream, musing in unwonted solitude, or enjoying the society of some intelligent companion, the whole scene is enchantment. The green pastures, where the sober cattle crop the sweet herbage as it springs luxuriantly beneath their feet, or recline on some sunny bank, or in some shady glade, chewing the cud in silent joy; the hills studded over with flocks of sheep, whence at intervals the bleating of the playful lamb is responded to by the voice of maternal affection; the neighbouring groves, in all the leafy pride of summer,

'Shade unperceived, so softening into shade,
And all so forming an harmonious whole,'

where music pours its 'wood-notes wild,' in a hundred varied cadences on the delighted ear; the flowers, which the earth flings in such profusion from her green lap, with their numerous forms and tints, always elegant and beautiful, and their mingled perfume so balmy, grateful, and refreshing,—all raise the well-constituted mind to the contemplation of the great source of this profusion of bounties,—Himself how bountiful! —In this frame of mind let the admirer of Nature, during his rural rambles, come suddenly on a party engaged in the preparatory employments of sheep-shearing, the most picturesque of all the pastoral operations; the bleating sheep, as they are one by one abstracted from the fold and plunged into the clear stream, where sturdy hinds are stationed to receive them, and free their fleeces of their impurities; and the busy groups of men, women, and children, each engaged in their several departments, or standing on the brink of the pool, pleased witnesses of a scene attended with so many agreeable associa-

tions; the whole animated picture, as it rises on his view, will excite sensations, which it is more easy to conceive than to analyse.

How deeply seated and how mysterious are the sources of enjoyment, yet how readily called into action. Every thing in rural scenery excites it; the voice of pleasure, from the various tribes of inferior animals, in all their different tones, excites it; the very bustle of business, with the eagerness and emulation arising from some common pursuit, excites it; above all, sympathy with human joy excites it, whether that sympathy is kindled by the smile of pleasure illuminating the countenance of our fellows, or the sprightly conversation of men free from care, or the song bursting from hearts full of gladness. Man is formed to enjoy; and, even in his journey through this checquered world, a bountiful Providence strews his path with enjoyment.

ELEVENTH WEEK—SUNDAY.

CHRIST, THE GOOD SHEPHERD.

The life of a shepherd is interesting, and sometimes adventurous. In pastoral countries, where there is frequently a vast extent of wild mountain ranges, his charge is anxious and incessant. He has to lead his sheep to the best pastures; to prevent them from straying beyond their proper bounds; to seek out the weak and diseased, and nurse them with tender care. In the spring he has to attend to the new dropt lambs; in summer his flock yield their fleeces, and the duties attending this operation, which are numerous, require skill and judgment. During winter he must redouble his care, amidst rains, and frosts, and snows: The grass no longer grows on the hills, and he must seek for it in the valleys; the storms come, and he must find the flock shelter; sometimes the snow falls thick and deep, and buries them beneath its drifted heaps,

and the shepherd must seek for them at the risk of his life, wandering over trackless moor and mountain, where all the usual landmarks are covered, and he is in perpetual danger of losing his way, and falling into some treacherous bog, or over some concealed precipice. Still, if he survive these perils, full of affectionate solicitude, he eagerly and anxiously hurries on, accompanied by his faithful dog, till he discovers his lost charge, and extricates them from their fearful situation.

In foreign countries, where beasts of prey abound, the shepherd has additional cares; he must be perpetually on the alert to defend his flock from the attacks of the wolf, the lion, the tiger, and the bear; and his own life, if he be faithful to his charge, is frequently endangered in encounters with these enemies. David, while yet a youthful shepherd, had more than one opportunity of evincing his courage and fidelity in protecting his sheep from such depredators; and when urging on Saul his claim to encounter the Philistine giant, he thus, with a gallant simplicity, describes his own prowess:—'Thy servant kept his father's sheep, and there came a lion and a bear and took a lamb out of the flock. And I went out after him, and smote him, and delivered it out of his mouth, and when he arose against me, I caught him by the beard, and smote him, and slew him. Thy servant slew both the lion and the bear; and this uncircumcised Philistine shall be as one of them, seeing he hath defied the armies of the living God.'

The dog, which is of such essential service to the shepherd in our own days, does not appear to have been employed by the Israelites, notwithstanding they were an essentially pastoral people. The reason may probably have been, that this animal was ranked among unclean beasts; and in eastern countries the habits of the wild race were always ravenous and disgusting. We might be at a loss to conceive how the large flocks reared by that people could have been adequately attended to without the aid of so useful a servant, did we not know that the Author of Nature has provided, in the instinct of the sheep, the means of obviating the difficulty, and that

man, who is fertile in expedients, was not slow in discovering and taking advantage of it. Like various other gregarious animals, the sheep naturally follow a leader, which is capable of being taught to obey the human voice. It is in this way that the flocks of the Israelites were kept under control, and the labours of the shepherd were abridged and rendered efficient.

Mr. Murray, in his 'Summer in the Pyrenees,' gives an interesting account of the obedience of the sheep to the call of the shepherd in these pastoral regions, which throws light on the mode of management among the ancient Hebrews. 'The celerity,' says he, 'with which the shepherds of the Pyrenees draw their scattered flocks around them, is not more astonishing than the process by which they effect it is simple and beautiful. If they are at no great distance from them, he whistles upon them, and they leave off feeding, and obey the call; if they are far off and scattered, he utters a shrill cry, and instantly the flock is seen leaping down the rocks, and scampering towards him. Having waited until they have mustered round him, the shepherd then sets off in his return to his cabin or resting-place, his flock following behind him, like so many well-trained hounds. Their fine-looking dogs, a couple of which are generally attached to each flock, have nobler duties to perform than that of chasing the flock, and biting the legs of stragglers,—they protect it from the attacks of wolves and bears, against whose approach they are continually on the watch, and to whom they at once offer battle. So well aware are the sheep of the fatherly care of these dogs, and that they themselves have nothing to fear from them, that they crowd around them, as if they really sought their protection; and dogs and sheep may be seen resting together, or trotting after the shepherd, in the most perfect harmony. There is no such sight to be witnessed in these mountains as "sheep-driving,"—no "knowing little collies" used in collecting the flocks, or keeping them from wandering. The Pyrenean shepherd, his dog, and his flock, seem to understand each other's duties. Mutual security and affection are

the bonds which unite them. The same confidence subsist. betwen the Pyrenean shepherd and his flock, as that between the shepherd of Palestine and his.'

What I have chiefly in view in this description of a shepherd's life, is the illustration of those metaphorical allusions which are made in Scripture to that occupation, in reference to the character and offices of the Saviour. The most remarkable of the passages where such allusions are found, is that in which Christ speaks of himself under this image.—'I am the good shepherd,' says he; 'the good shepherd giveth his life for the sheep: but he that is an hireling, and not the shepherd, whose own the sheep are not, seeth the wolf coming, and leaveth the sheep and fleeth, and the wolf catcheth them, and scattereth the sheep. I am the good shepherd, and know my sheep, and am known of mine. And other sheep I have which are not of this fold, them also I must bring; and they shall hear my voice, and there shall be one fold, and one shepherd.' And again, 'He that entereth in by the door is the shepherd of the sheep. To him the porter openeth; and the sheep hear his voice; and he calleth his own sheep by name, and leadeth them out; and when he putteth forth his own sheep, he goeth before them, and the sheep follow him, for they know his voice.'*

There are two views of the Redeemer chiefly alluded to in this beautiful metaphor: He is represented, first, as our affectionate guide; and, secondly, as the preserver of our lives by the sacrifice of his own. In reference to the first of these views, we find a similar and scarcely less striking allusion in the 23d Psalm,—'The Lord is my shepherd, I shall not want. He maketh me to lie down in green pastures: He leadeth me beside the still waters. He restoreth my soul: He leadeth me in the paths of righteousness for his name's sake. Yea, though I walk through the valley of the shadow of death, I will fear no evil: for thou art with me; thy rod and thy staff they comfort me.' In the prophecies of Isaiah, too, the same sentiment is gracefully and tenderly expressed,—'He shall

* John chap. x.

feed his flock like a shepherd: He shall gather the lambs with his arm, and carry them in his bosom, and shall gently lead those that are with young.'*

The intimate and endearing relation which subsists between Christ and his church, is elsewhere represented with not less force, sometimes under the figure of a bridegroom and his bride,—and at other times, under that of the head, giving life and intelligence to the various members of the body. There is nothing, indeed, too intimate or too endearing to characterize this union. He is our master, our friend, our elder brother; and in all these capacities he directs, advises, instructs us,—consults our best interests; exercises over us the gentle authority of a parent, with all the tender affection of an equal. His word is a light to our feet and a lamp to our path: his Holy Spirit enlarges, comforts, sanctifies us; cleanses us from the pollutions of earth; prepares us for the enjoyments of heaven.

But Christ, the good shepherd, is also the preserver of our lives; and at what expense? 'The good shepherd giveth his life for the sheep.' This crowns all his labours of love. 'Scarcely for a righteous man will one die,' says an apostle, 'yet peradventure for a good man some would even dare to die. But God commended his love towards us, in that, while we were yet *sinners*, Christ died for us.' Jesus himself represents the sacrifice of one's life as the highest and most generous act of friendship,—'Greater love hath no man than this, that a man lay down his life for his friends.' How then shall we characterize the love of this most amiable and admirable of Beings, when we remember that he laid down his life for his *enemies*. In every way his disinterested affection exceeded that of any mere mortal. To die for a good man and a friend, is the climax of human love; but Christ died for sinners and enemies! His love was boundless, incomprehensible, God-like;—and it is so still. He who died for our sins rose again for our justification. He is still the shepherd of our souls. 'Who shall separate us from the love of Christ?

* Isaiah xl. 11.

Shall tribulation, or distress, or persecution, or famine, or nakedness, or peril, or sword? Nay, in all these things we are more than conquerors, through him that loved us.'

ELEVENTH WEEK—MONDAY.

THE SHEPHERD'S DOG.

In the 'Winter' volume I noticed the sagacity of the dog, in extricating its master or casual passengers from danger, during storms of snow. This, however, I need not observe, is only one feature in the character of an animal, which, of all others, is most obviously given to man at once as his servant, his companion, and his friend. Cicero says of this animal, 'Such fidelity of dogs in protecting what is committed to their charge, such affectionate attachment to their masters, such jealousy of strangers, such incredible acuteness of nose in following a track, such keenness in hunting,—what else do such faculties evince but that these animals were created for the use of man.'*

Every thing, indeed, connected with the dog, proves the truth of this conclusion of the heathen orator. The dog prefers the society of man to that of his own species; he rapidly improves under human tuition; the species, in his domesticated state, has passed into distinct varieties, differing greatly from each other in their powers and instincts, but all endowed with faculties useful to man, and occupying positions to which their faculties are especially adapted. The experience of Mr. Burchell, during his travels in Africa, afforded him an opportunity of judging of the utility of these peculiarities in different varieties, and he thus expresses himself: 'Our pack of dogs consisted of about five-and-twenty, of various sorts and sizes.

* Canum vero tam fida custodia, tamque amans dominorum adulatio, tamque odium in externos, et tam incredibilis ad investigandum sagacitas narium, tanta alacritas in venando, quid significat aliud, nisi se ad hominum commoditates esse generatos.—Cicero, *De Natura Deorum.*

This variety, though not altogether intentional, as I was obliged to take any that could be procured, was of the greatest service on such an expedition, as I observe that some give notice of danger in one way, and others in another. Some were more disposed to watch against men, and others against wild beasts; some discovered an enemy by their quickness of hearing, others by that of scent; some were useful for speed in pursuing game; some for their vigilance and barking, and others for their courage in keeping ferocious animals at bay. No circumstance could render the value and fidelity of these animals so conspicuous and sensible as a journey through regions, which, abounding in wild beasts of almost every class, gave continual opportunities of witnessing the strong contrast in their habits between the ferocious beasts of prey which fly at the approach of man, and these kind, but too often injured, companions of the human race.'

But it is the shepherd's dog which at present claims our particular attention. This variety, is indeed, one of the most remarkable of the whole tribe, for its fidelity and intelligence. He is easily trained to know the nature and extent of his sphere of duty; he perfectly understands all the ordinary commands of his master, and with admirable sagacity, united to the most unwearied industry and perseverance, he executes them.

The Ettrick Shepherd has recorded some instances of the peculiar faculties and habits of the shepherd's dog, in which he unites the advantage of experience with happy powers of description; and I cannot better illustrate the extraordinary adaptation of this interesting animal to the service of man, than by selecting one or two of his examples.

'My dog Sirrah was, beyond all comparison, the best dog I ever saw. He was of a surly and unsocial temper; disdaining all flattery, he refused to be caressed; but his attention to my commands and interests will never again perhaps be equalled by any of the canine race. When I first saw him, a drover was leading him by a rope. He was both lean and hungry, and far from being a beautiful animal.' 'He was

scarcely a year old, and knew so little of herding, that he had never turned a sheep in his life; but, as soon as he discovered that it was his duty to do so, and that it obliged me, I can never forget with what anxiety and eagerness he learned his several evolutions. He would try every way deliberately, till he found out what I wanted him to do; and when I once made him understand a direction, he never forgot or mistook it again. Well as I knew him, he often astonished me; for, when hard pressed in accomplishing the task that he was put to, he had expedients of the moment that bespoke a great share of the reasoning faculty."*

One of Mr. Hogg's anecdotes of this favourite dog's exploits, I may shortly state.—About 700 lambs, which Mr. Hogg had under his care at weaning time, broke off at midnight, in three divisions, to the neighbouring hills. The night was dark, but the faithful Sirrah, though unseen, was at hand, and hearing his master lamenting the disaster, set silently off in search of the recreant flock. Hogg and a companion searched all night for the runaways, but in vain; and in the morning were under the necessity of returning to relate the disaster to their owner. On their way home, however, they discovered a lot of lambs at the bottom of a deep ravine, called the Flesh Cleuch, and the indefatigable Sirrah standing in front of them, looking round for assistance. 'What was our astonishment,' says he, 'when we discovered that not one lamb of the whole flock was wanting! How he had got all the divisions collected in the dark, is beyond my comprehension. The charge was left entirely to himself from midnight to the rising sun; and if all the shepherds in the Forest had been there to have assisted him, they could not have effected it with greater propriety. All that I can further say is, that I never felt so grateful to any creature under the sun, as I did to my honest Sirrah that morning.'†

In another part of his work, Mr. Hogg relates an anecdote of a dog belonging to a butcher, in the town of Peebles, of the name of Steel, which indicates a degree of fidelity and attach-

* Hogg's Shepherd's Calendar. † Ibid.

ment to his master's interests, remarkable above any thing I have seen elsewhere recorded of this animal, exhibiting these qualities as even superior to bodily pain, and the most pressing calls of the strongest of the natural instincts. Mr. Steel was accustomed to commit droves which he purchased, to the charge of this dog, which happened to be a female, and he had a pride in trusting to her prowess and sagacity in driving them unaided to his home. One day he chanced to place a drove under the conduct of his dog, at a place called Willenslee, which is five miles from Peebles, over wild hills, where there is no regularly defined path. The poor dog was heavy with pup, a circumstance to which Mr. Steel had not adverted. She was taken in travail on the road, and thus was detained some time later than was expected. Steel, on returning home in the evening, finding she had not made her appearance, was on the point of setting out in search of her and her charge, 'but, on his going out to the street, there was she coming with the drove, not one missing; and, marvellous to relate, she was carrying a pup in her mouth! How the poor beast had contrived to manage the drove, in her state of suffering, is beyond human calculation; for her road lay through sheep the whole way. Her master's heart smote him when he saw what she had suffered and effected; but she was nothing daunted; and, having deposited her young one in a place of safety, she again set out full speed to the hills, and brought another and another, till she removed her whole litter, one by one; but the last one was dead.'

It would be endless to relate all the instances of extraordinary sagacity in the shepherd's dog, which have been recorded; and I shall close this paper with an anecdote related by Captain Brown, I know not on what authority, which indicates a degree of reasoning, and disinterested kindness, not certainly superior to what we have already mentioned, yet of a different and not less interesting kind:—'A shepherd on the Grampian mountains, having left his child at the foot of a hill, was soon enveloped in mist; and, unable to return to the precise place, he could not discover the child. In vain

he searched for it in the midst of the mist, not knowing whither he went; and, when at length, the moon shone clearly, he found himself at his cottage, and far from the hill. He searched in vain next day, with a band of shepherds.

'On returning to the cottage, he found that his dog, on receiving a piece of oat-cake, had instantly gone off. He renewed the search in vain next day, and again found on his return that the dog had disappeared during the interval, taking with it a piece of cake. Struck with this circumstance, he resolved to watch the motions of his dog, and, when it again came for its piece of cake, he followed it. The dog led the way to a cataract, at some distance from the place where the shepherd had left the child. The banks of the waterfall almost joined at the top, yet separated by an abyss of immense depth, presenting that abrupt appearance which so often astonishes and appals the traveller amidst the Grampian mountains. Down one of these rugged and almost perpendicular descents the dog began, without hesitation, to make his way, and at last disappeared in a cave, the mouth of which was almost on a level with the torrent. The shepherd with difficulty followed; but, on entering the cave, what were his emotions, when he beheld his infant eating with much satisfaction the cake which the dog had just brought him, while the faithful animal stood by, eyeing his young charge with the utmost complacence. From the situation in which the child was found, it appears that he had wandered to the brink of the precipice, and either fallen or scrambled down, till he reached the cave, which the dread of the torrent had afterwards prevented him from quitting. The dog, by means of his scent, had traced him to the spot, and afterwards prevented him from starving by giving up to him his own daily allowance. He appears never to have quitted the child, except when he went for its food, and then he was seen running at full speed to and from the cottage.'*

Many anecdotes, perhaps none quite so wonderful as those I have selected, but sufficiently marked to show that the

* Brown's Anecdotes of the Animal Kingdom, p. 255.

dog has not only the kindliest affections, but an intelligence and power of reasoning far superior to mere instinct, must occur to the recollection of every reader; and who can think of these without coming to the same pious conclusion with Cicero, that the dog was 'created for the use of man.'

ELEVENTH WEEK—TUESDAY.

RUMINATING QUADRUPEDS.—THE COW.

The cow is among the most useful, the most generally diffused, the most various in kind, and the longest domesticated of quadrupeds. Man may be said to be more dependant on this race than on any other which the Creator has in his wisdom called into existence; and the readiness with which it accommodates itself to the nature of its food, and increases or diminishes in size, according to the plenty or scarcity of the pasture, and the circumstances of climate, is an obvious indication of benevolent accommodation to the varied localities in which the human family, whose habitation it was destined to accompany, were to be found.

The races of cattle, as we find them domesticated in Europe, differ from each other more in size than in any other particular; but when we pass into warmer climates, a change takes place which would almost make us believe that we were contemplating a distinct species. Instead of the straight back, the square-turned head, the small ears, and the short muscular limbs of our cattle, the Indian ox, or Brahmin bull, as it is commonly called, is distinguished by a more elongated form of skull, with a decidedly concave line of profile, an arched neck, a hump of fatty substance rising from the withers, an arched back, sinking and rounded off on the crupper, an enormous dewlap, hanging down in folds, long pendulous ears, and limbs long and taper. This race, of which numerous breeds occur, varying in size from that of a large mastiff to that of a full-grown buffalo, is spread, more or less exten-

sively, over the whole of southern Asia, the islands of the Indian Archipelago, and the eastern coast of Africa, from Abyssinia to the Cape of Good Hope. In all these countries, the zebu (for so is the humped variety termed), supplies the place of the cow, both as a beast of burden and an article of food and domestic economy. In some parts of India, it executes the part of a horse also, being either saddled and ridden, or harnessed in a carriage, and performing in this manner journeys of considerable length with tolerable celerity.*

It is the same race which Goldsmith describes under the name of bison, and of one of whose breeds, domesticated by the Hottentots, he gives the following interesting account:—'They are their fellow domestics, the companions of their pleasures and fatigues: the cow is at once the Hottentot's protector and servant; assists him in attending his flocks, and guarding them against every invader. While the sheep are grazing, the faithful backely, as this kind of cow is called, stands or grazes beside them; still, however, attentive to the looks of its master, the backely flies round the field, herds in the sheep that are straying, obliges them to keep within proper limits, and shows no mercy to robbers, or even strangers, who attempt to plunder. But it is not the plunderers of the flock alone, but even the enemies of the nation, that these backelies are taught to combat. Every army of Hottentots is furnished with a proper herd of these, which are let loose against the enemy when the occasion is most convenient. Being thus sent forward, they overturn all before them; they strike every opposer down with their horns, and trample upon him with their feet, and thus often procure their masters an easy victory, even before they have attempted to strike a blow.† An animal so serviceable, it may be supposed, is not

* The Gardens Delineated.

† It may be doubted whether or not the backely is *trained* to the combat, although used in the way described. The Irish rebels were in the habit of employing cattle in the same manner with considerable effect, against the king's troops. Having driven the infuriated herds, with violence and much shouting, against the approaching troops, they sometimes

without its reward. The backely lives in the same cottage with its master, and, by long habit, gains an affection for him; and, in proportion as the man approaches to the brute, so the brute seems to attain even to some share of human sagacity. The Hottentot and his backely thus mutually assist each other; and, when the latter happens to die, a new one is chosen to succeed him, by a council of the old men of the village. The new backely is then joined by one of the veterans of his own kind, from whom he learns his art, becomes social and diligent, and is taken for life into human friendship and protection.'*

There is an air of romance in this account, for which perhaps some allowance should be made; but that the bison is in some respects more active and intelligent than our domestic cow, may easily be conceived,—the training of the latter being of a kind to render its faculties more obtuse, rather than to sharpen them. It is well known that the Indian breed is more expert and docile than ours. Many of them, when they carry burdens, bend their knees to take them up or set them down. Some of the native tribes employ their oxen for riding, as we do horses. They are treated by the natives with a degree of tenderness and care equal to their utility; and the respect for them in India has even degenerated into blind adoration.

In turning again to the European breed, we find the most remarkable differences arising solely from difference of pasture. Among the Eluth Tartars, for example, where the pastures are remarkably rich and nourishing, the cow rises to the height of seven or eight feet; in the mountainous districts of France, on the contrary, where it is stinted in its sustenance, and driven from the most nourishing pastures, it is dwarfish and degenerated,—proving that it is food rather than climate which encourages the growth of this animal.

Of all animals, except man, the cow is perhaps the most

succeeded in breaking the best disciplined ranks, and thus prepared for an advantageous onset.

* Animated Nature, vol. i. p. 532.

extensively propagated. Its nature is equally capable of sustaining the rigours of heat and cold,—of inhabiting the frozen fields of Iceland, as well as the burning deserts of Lybia. It seems, in some of its forms, an ancient inmate in every climate,—domestic or tame in those countries which have been civilized,—savage and wild in the countries which are less peopled, but capable of being made useful in all; able to defend itself in a state of nature, from its enemies of the forest, and only subordinate to man, for whose comfort it was formed, and to whose dominion it readily yields. The wild animals preserve their nature and their form with inflexible perseverance; but this, and other creatures which have acquired the title of domestic, suit themselves with astonishing facility to the appetites and conveniences of man, changing their dispositions and instincts, as well as their shape, so as to be accommodated to the peculiar locality in which he is placed, and to be subservient in all situations to his use.

I need not enumerate all the blessings which the Creator has bestowed on man in the possession of this useful quadruped. Every one is acquainted with the patient labour of the ox, and knows that the female supplies him with a delicious beverage, which, when prepared in the form of butter and cheese, furnishes agreeable varieties to the luxuries of his table; and that, when the animal is killed, its flesh affords him substantial and acceptable food, and its hide contributes in various ways to his service in the form of leather, while its very bones are ground down to manure and fertilize his fields.

ELEVENTH WEEK—WEDNESDAY.

THICK-SKINNED QUADRUPEDS.—THE HOG.

The domestic animals which yet remain to be noticed, are those of the order *Pachydermata*, so called from the thickness of their skins. This order consists of several *genera*, differing from each other in various marked particulars; but of these

there are only three which deserve to be ranked among domesticated animals, namely, the hog, the horse, and the elephant.

The domestic hog is the descendant of a race still wild in the larger forests of Europe, Asia, and the northern parts of Africa. The wild race is easily reclaimed; but is distinguished from the domesticated breed by its colour, which is a dark grizzled brown; by its greater length of limb; its small ears, and the greater development of its snout.

In his native forest the wild boar is a most formidable animal; and, although he does not court the combat, yet, when hard beset, he defends himself with the most determined energy, his strength and tusks rendering him a terrific opponent. This animal, in his wild state, can properly be called neither solitary nor gregarious. The three first years the whole litter follows the sow, and the family lives in a herd together. They are then called beasts of company, and unite their common forces against the invasions of the wolf, and the other formidable animals of prey. Upon this, their principal safety, while young, depends; for, when attacked, they afford mutual assistance, calling to each other with a very loud and fierce note. The strongest face the danger; they form a ring, and the weakest fall into the centre. In this position few ravenous beasts dare venture to attack them. When the wild boar, however, has arrived at a state of maturity, and has become conscious of his superior strength, he then ranges the forest fearless and alone. At this period of his existence he dreads no single creature, nor does he turn out of his way even for man himself.

I have already noticed the peculiarity in the form of the hog's snout, obviously contrived to constitute an instrument corresponding to its instincts in the selection of food in its wild state. When tamed, the animal was intended to occupy, in the domestic economy, the useful station of a consumer of all manner of offal and garbage; and, for this purpose, it is furnished with a most accommodating taste, and powerful stomach. The reader will probably be, therefore, surprised

to learn, that this grossly and indiscriminately feeding animal, is in its natural forests rather remarkable for an opposite tendency. The truth is, however, that it is of all quadrupeds, in its wild state, the most select in its choice of its vegetable food. The cow, for example, according to Linnæus, eats 276 plants, and rejects 218; the goat eats 449, and rejects 126; the sheep eats 387, and rejects 212; but the hog eats but 72, and rejects all the rest. It is true that it does not refuse animal food, even in a putrescent state, when it happens to come in its way; but it does not seek for it, and seems rather to devour it from necessity than from preference; and where food is abundant it becomes quite dainty in its choice. In the orchards of peach trees in North America, where the hog has plenty of delicious food, it is said that it will reject the fruit that has lain but a few hours on the ground, and patiently wait whole hours for a fresh windfall.

The hog is the most prolific of the domesticated quadrupeds, unless we include the rabbit in that number. These animals live and multiply in every climate of the world, with the exception of the polar regions. They are capable of reproduction at nine months old, and their natural life extends to fifteen or twenty years. The production of fifteen or twenty in a litter is not unfrequent, and instances have been known in which double that number has been produced. The celebrated Vauban has made a calculation of the probable production of an ordinary sow and her progeny, during the space of ten generations. After making every reasonable allowance, estimating the ordinary average of a litter so low as six, and even excluding the males, the result is, that the product of a single sow, in that period, will be six millions, four hundred and thirty-four thousand, eight hundred and thirty-eight pigs. Taking it, however, in round numbers, at six millions, we have a produce nearly equal to the whole number existing in France. 'Were we to extend our observations,' says this naturalist, 'to the twelfth generation, we should find as great a number to result, as all Europe would be capable of supporting; and were they to be confined to

the sixteenth, as great a number would result as would be adequate to the abundant peopling of the globe.' A remarkable instance of this animal's fecundity, occurred in Leicestershire, where a sow, belonging to Mr. Thomas Richdale, Kigworth, had, in the year 1797, produced three hundred and fifty-five pigs, in twenty litters. The editor, who states these facts in a note to Goldsmith's Animated Nature, mentions, at the same time, an instance of a sow, bred near Donaghadee, which, in the course of nine months, brought its owner, by its produce, within a few shillings of £80 of profit.

The remarkable fecundity of this animal, the nutritious nature of its flesh, in temperate climates, and the ease with which it is reared and fed, point it out as a valuable possession for the lower classes. Let the consumption be what it may, there will always be an ample supply for the demand. In the country, there are few families that cannot rear at least one pig every year, and thus obtain a cheap and nutritious diet, not to mention the profit arising from the lard, fat, &c. of the animal. Or, if the peasantry are too poor to raise a pig for their own subsistence, they can at least, by its sale, procure a sufficient sum to enable them to pay their house-rent, and even, in addition, to purchase some necessaries; and, in fact, in very many of our rural districts, this is the manner in which the labouring poor contrive to keep the family roof over their heads. The hog is, indeed, peculiarly and emphatically the poor man's domestic animal.

ELEVENTH WEEK—THURSDAY.

THICK-SKINNED QUADRUPEDS.—THE HORSE AND THE ASS.

Dr. Macculloch, in proving that certain animals were distinctly created for the use of man, particularizes, among others, the horse and the ass; and his observations on these well-known animals are so appropriate, that I need do little

more than quote his words. After speaking of the camel, which is only known as the servant and follower of man, which kneels to be loaded without instruction, and which has a provision in its knees and breast for that purpose, he thus proceeds :—

'In spite of much research and much contest, the wild and original state of the horse is equally unknown. I quote the most recent and sober opinions, divested of all views of the present nature, in saying that this animal is nowhere wild at this day, except where it appears to have escaped from the domestic state. Was it ever so, any more than the camel? It is more widely necessary to man, and equally adapted to his wants. I know not why it should not have been created with and for him,—essentially domestic, his appointed servant. On what grounds is the reverse determined? Men commence by forming an opinion, and are somewhat surprised when asked to assign the reasons; yet it is thus that knowledge is obstructed, and truth becomes unattainable. Were it otherwise, the present argument would not lose a grain in weight, when the temper, dispositions, forms, powers, every thing of this first of all quadrupeds is considered, with their perfect adaptation to the uses which are derived from it. Its back is that which man would have made for his own use, had he constructed it; the mouth is almost the only one which bears the bit without suffering; it has the only foot (if I except its congeners), which will endure an additional weight under rapid motion; it is the only wild animal, of similar power, which is tamed in a few hours; and nothing but an appointed instinct, could have thus taught it to submit, and even to rejoice in its rider. How easily it is attached to man, and to human society, I need not say. But the proofs must not be sought for in our own country, where men are not satisfied unless they gain, by severity and force, that which would be voluntarily and cheerfully given to kindness.'*

To this pointed and comprehensive description I may add that the horse, like other domestic animals, is capable of hav

* Attributes of God, vol. iii. p. 131.

ing his faculties improved by the skill of man, an adaptation doubtless intended for a benevolent purpose, although not always worthily employed. Is swiftness the object? an animal is produced that rivals the wind:* Is it strength that we require? look at the English dray-horse,† which is only excelled in its powers by the elephant: Do we seek for endurance of fatigue? the Toorkomans will furnish an example, whose cavalry are trained to advance and retreat at the rate of a hundred miles a-day.‡ The size, the quality, the docility, are all suited to every locality and occasion, which man finds necessary for his use, from the Shetland pony to the British race-horse and courser.§

* The race-horse Childers ran at the rate of nearly a mile in the minute, or forty-nine feet in a second.

† On Surrey Iron Railway, a horse dragged fifty-five tons, walking at the rate of four miles in the hour.

‡ This account is given by Sir John Malcolm; and he adds, 'When I was in Persia in 1800, a horseman mounted on a Toorkoman horse, brought a packet of letters from Shiraz to Zeherary, which is a distance of five hundred miles, within six days.

§ The horse, though not naturally inclined to swim, will sometimes make remarkable efforts in this way. A few years ago, a gentleman residing in the neighbourhood of Dumfries, in riding at night along the shore from Skinburness to Boness, on the Cumberland coast, mistook his way in passing a creek, being deceived by a light on the Scotch side. His horse carried him directly across the Solway Frith, and he landed at Newby, not far from Annan. The distance is fully two miles, but the horse did not perhaps swim more than a third part of that way, the tide being low. A much more remarkable feat is described by M. de Pages, in his Travels round the World, and confirmed by Sparman, of a horse which saved some seamen ready to perish in a wreck off the Cape of Good Hope. 'The sea ran dreadfully high, and broke over the sailors with such amazing fury, that no boat whatever could venture off to their assistance. Meanwhile a planter determined to make a desperate effort for their deliverance. He alighted, and blew a little brandy into his horse's nostrils, and again seating himself in the saddle, he instantly pushed into the midst of the breakers. At first both disappeared, but it was not long before they floated on the surface, and swam up to the wreck; when, taking with him two men, each of whom held by one of his boots, he brought them safe to shore. This perilous expedition he repeated no seldomer than seven times, and saved fourteen lives; but on his return the eighth time, his horse being

In speaking of this useful and noble animal, we are naturally reminded of the well-known and highly poetical description of the war-horse, contained in the book of Job:—

'The glory of his nostrils is terrible: he paweth in the valley, and rejoiceth in his strength: he goeth on to meet the armed men: he mocketh at fear, and is not affrighted; neither turneth he back from the sword. The quiver rattleth against him, the glittering spear, and the shield. He swalloweth the ground with fierceness and rage; neither believeth he that it is the sound of the trumpet. He sayeth among the trumpets "Ha, ha;" and he smelleth the battle afar off, the thunder of the captains and the shouting.'*

Of the ass, a kindred animal, Dr. Macculloch justly observes, that, through a precision of footing which is even augmented in the mule, it is fitted almost like the goat, for those mountain difficulties, where the horse becomes less serviceable; while its strength, patience, steadiness, and indurance of privation in food, form a combination of qualities, that point to the design, which allotted it as another servant to man.

From time immemorial, the ass, in eastern climes, has been the slave of man; but, in the latitudes of Europe, its introduction may be considered as comparatively recent, being unknown there in the time of Aristotle. It seems, indeed, to be more adapted to the hill country of more southern climates, and especially of the East. In Europe, it is dull, slow, and diminutive in size. In more genial regions, it is large, handsome, and spirited. It is therefore, frequently used among the Orientals, even at this day, in preference to the horse; and, in ancient times, it was there held in still greater estimation than at present. It will not be forgotten, that when our Lord made his triumphant entry into Jerusalem he was mounted on an ass's colt.

much fatigued, and meeting a most formidable wave, lost his balance, and was overwhelmed in a moment. The horse swam safely to land, but his gallant rider was no more.'

* Job xxxix. 20–25.

In considering the subject of domestic animals, we must not forget, that the advantage is not altogether on the side of man. It is an additional proof of Divine benevolence in this arrangement, that the benefit is reciprocal, and that the services bestowed upon us, are requited in our attentions towards them. By cultivation, we increase the quantity of food, not only for ourselves, but for the creatures whose aid we require; and, by thus augmenting the number of living beings, augment the sum of enjoyment. The chief happiness of the lower animals consists in an ample supply of food; and this, man bestows. He protects his herds and flocks from their numerous enemies; for their sakes, destroying the beasts of prey, or affording means of defence which they are themselves incapable of employing. Let any person compare the state of the sheep, the goat, the ox, and the horse, under the protection of man, with the privations and dangers they would have to endure, if left to range at large in the uncultivated forest, and he will at once perceive that their domestication must be considered as a blessing, not more with reference to man, than with reference to themselves.

It is true that there are some evils to be placed in the opposite scale, but these are light in comparison with the advantages. Sometimes a cruel master may overload or overwork his horse or his ox; but the check upon his cruelty is found in his selfishness; for he can never injure his servant without at the same time inflicting punishment on himself; and a kind Providence limits the sufferings of the brute creation to the moment, happily withholding from them, what so peculiarly embitters the lot of man, the recollection of evils that are past, and the anticipation of evils to come. They are slain for our use; but, even here, there is a beneficient provision; for, as death must come, it is well that it arrives with little pain, and, after a state of enjoyment from ample feeding; rather than that the animal should die of famine, or of the infirmities of age, or be torn to pieces by wild beasts. The death of one animal, too, affords place for the subsistence of

another full of vigour, and, buoyant with youthful enjoyment; so that here also the sum of happiness is increased.

ELEVENTH WEEK—FRIDAY.

THICK-SKINNED QUADRUPEDS.—THE ELEPHANT.

The elephant, which is the last example of the lower animals I shall notice, may rather be said to be a tamed than a domestic animal. It is seldom reared from the birth in those countries where it is employed for the use of man, as it is found more advantageous to obtain it in its wild state, when already some years old. The possibility, indeed, of raising it in a domestic state was long doubted, but this is now found to be a prejudice connected with some superstitious notions.

The elephant is the largest animal which now treads the surface of our globe, although it dwindles to a pigmy when compared with some of the inhabitants of the earth, in a primeval period. There are peculiarities in its form, which exhibit a remarkable adaptation to its enormous bulk. Among these has been noticed the formation of its legs, which differ from those of all other animals, in being strong and massive pillars, evidently framed with admirable mechanical skill for sustaining an immense weight. But the most remarkable contrivances for counteracting the inconvenience arising from gravity, are to be found in the neck and proboscis. The head, itself large, contains two heavy tusks, and the weight could not be conveniently borne at the end of a long neck; besides that the animal was to be formed with the power of raising immense weights with this portion of its body. The neck is therefore made comparatively very short, so that it will not admit of the mouth reaching the ground to feed. But, to counterbalance this defect, and also to overcome the difficulty arising from the tusks, the elephant is provided with an instrument of admirable structure, in its proboscis or trunk, which has been thus described:—It is composed entirely of

bundles of muscular fibres enclosing two canals. By their contraction or relaxation, these muscles are capable of drawing up, shooting out, or twisting in any direction, the organ which they compose: indeed, the pliability and power it possesses may, in some degree, be conceived from the account of Cuvier, who has ascertained that the number of distinct muscles, each having its distinct action, is not far short of forty thousand. Hence that union of strength and precision, force and address, which this exquisite piece of mechanism exhibits, and which so well proclaims the wisdom and skill of the Great Designer. The canals of the proboscis are for the purpose of drawing up any liquid, which is afterwards discharged into the throat, or over the body at pleasure. They are in fact two self-acting syringes. The proboscis itself is terminated with a flexible instrument, called a finger, which serves a purpose not unlike the human finger, as by pressing against the division between the two canals, it can hold any small object with the greatest facility. With this little instrument, it can even pick up a pin; and hence this noble animal is endowed with the faculty, almost peculiar, except in this instance, to man, of examining objects with precision by the touch, which, in conjunction with its native intelligence, has ranked it as the first of quadrupeds, even when judged of by a more honourable criterion than that of bulk.

The first and most essential property of the trunk is to supply the animal with food; for, with this, it can despoil the trees of their young shoots and leaves, overturn the mimosa trees, that it may feed on their succulent roots, and crop the herbage of the fields. But it also employs this instrument in various other ways, as occasion requires, especially when employed in the service of man. It rarely, however, uses it as a weapon of offence, seeming sensible of its value, and carefully preserving it from injury.

The average height of the elephant is nine or ten feet, though it frequently rises as high as fifteen feet. Its weight varies from four thousand to nine thousand pounds. When tamed, it becomes the most gentle, obedient, and affectionate

of domestic animals, capable of being trained to any service necessary in those warm countries of which it is a native.

Only two species of the elephant at present exist, the Asiatic and African; but the remains of several extinct species are met with in almost every part of the world, particularly in Asiatic Russia.

Elephants hold undisputed sway in the mighty forests which they inhabit; their immense size, united strength, and great swiftness, enabling them to dislodge all intruders on their abode. The lion and tiger avoid such formidable assailants, and leave them in undisputed possession of their forest. Seemingly sensible of the large supply of food which they require, they will allow no animal, however peaceable, to browse in their territories, of which they hold exclusive possession; and they can only exist in those extensive woody ranges, or immense plains, where vegetation abounds in all its wild luxuriance.

The strength of the elephant, conjoined with its sagacity, renders it a most efficient servant, where extraordinary animal force is required, as in dragging ships, heavy stores, and ordnance. Captain Williamson observes, that many of our most arduous military operations have been greatly indebted for their success to the sagacity, patience, and exertion of the elephant; and states, in particular, that, 'when cannon require to be extricated from sloughs, the elephant, placing his forehead on the muzzle, which, when limbered, is the rear of the piece, with an energy scarcely to be conceived, will urge it through a bog, from which hundreds of oxen or horses could not drag it. At other times, lapping his trunk round the cannon, he will lift while the cattle and men pull forwards.'

The quickness of comprehension displayed by this noble animal, has justly procured for him the appellation of the 'half reasoning elephant.' 'I have myself,' says an officer who served in India, 'seen the wife of a *mohaut* (for the followers often take their families with them to the camp), give a baby in charge to an elephant, while she went on some business, and have been highly amused in observing the saga

city and care of the unwieldy nurse.' In corroboration of this statement, I may notice the curious fact mentioned in the 'Philosophical Transactions,' of the attachment of an elephant to an infant. He was said never to have been happy except when the infant was near him. The nurse, therefore, frequently took the child in its cradle, and placed the latter between his feet. He at last refused to eat his meat when the infant was absent. When it was asleep, he watched it with much solicitude, and drove off the flies with his trunk as they approached. If it awoke and cried, he would rock the cradle, till it again fell asleep.

A thousand well authenticated accounts of the sagacity, the docility, the quick sense of injury, and the affectionate disposition of the elephant are stated, from which I shall only select one well known example, that is at once characteristic of almost all these qualities. 'Some years ago, an elephant at Decan, from a motive of revenge, killed its conductor. The wife of the unfortunate man was witness to the dreadful scene; and in the frenzy of her mental agony, took her two children, and threw them at the feet of the elephant, saying, "Take my life also, and that of my children!" The elephant becoming instantly calm, seemed to relent; and, as if stung with remorse, took up the eldest boy with his trunk, placed him on its neck, adopted him for its *cornac*, and never afterwards allowed another to occupy that seat.'

ELEVENTH WEEK—SATURDAY.

REFLECTIONS ON THE DOMESTIC ANIMALS.

'DEPRIVE man of the ox, the dog, and the horse,' says Dr. Macculloch, 'and he could not maintain his position in the world for a year; he never could have attained the one which he holds, nor could he discover a compensation.' He who reflects on the vast importance these animals are to the comfort and convenience of man, and on the addition which they

afford to his power, will at once perceive that there is no exaggeration in this assertion. It may be true that, as society advances in civilization, new modes of acquiring power, and new means of increasing our comforts and conveniences, may be discovered, which shall leave these immediately accessible gifts of the Creator far behind; but even should the uses of the domestic animals be destined to be superceded or excelled by the inventions of man in a highly improved state, who will venture to say that they were not necessary to assist him in arriving at that state?

And let it not be said, that the properties of these animals have been only accidentally fitted for the use of man, and that he is entirely indebted to his own ingenuity, in the appropriation of instincts and faculties destined by Nature solely for a different purpose,—for the existence or the happiness of the animal itself. This view may be disproved—and, indeed, I think I may confidently say, has already been disproved—by reference to the nature of these instincts and faculties, and, it may be added, by reference to the very form and bodily structure of the creatures we have subjugated. That the horse is made for a rider, and the ox for patient endurance of fatigue, and the dog for a thousand little offices which contribute to the comfort of man, no person who candidly considers the correspondence of their forms with the nature of their faculties, and the correspondence of these, again, with the wants of the human race, can, without a most inveterate and perverse scepticism, allow himself for a moment to doubt.

One very remarkable fact, which has already come under our notice, in regard to the subject of domestication, is the effect which an intercourse of the lower animals with man for many generations produces, in changing their habits, their dispositions, their very bodily form, fitting them more perfectly for the supply of his various necessities. This is particularly the case with those that have been the longest reclaimed, and are the most needful to him. How numerous and useful are the varieties, for example, which we find in the dog and the horse! And what adds materially to the proof

of Creative Design, in this instance is the power which man possesses of improving the breeds, or rendering them more subservient to some particular uses. The sheep has been made to yield a finer fleece, the cow to give a more abundant supply of milk, the horse to become more fleet and powerful, the dog more sagacious, under the skill of man. This is one species of the rewards which the Supreme Governor, in pursuance of a very general principle employed by his paternal beneficence, has annexed to human industry and ingenuity,—a department of useful dicipline in the school of Providence. It is essential to man's welfare that his faculties shall be stimulated, and kept in constant exercise; and, in a thousand ways, arrangements have been made by the Creator to effect this important purpose.

Another observation, which cannot fail to strike the minds of those who study the subject of domestication, relates to the dispositions implanted in the various animals which are the objects of it. These dispositions were clearly bestowed for the purpose of rendering them fit for this state, whether we consider, in some species, their affections, which go forth towards man as their protector and benefactor; or, in others, their love of ease, which induces them to submit without resistance to his sway; or in others, again, their local attachments, which bind them to the place in which they have been brought up; or, finally, in others still, their very stupidity, which proves them to be born for a state of slavery.

Of the first of these qualities,—that of affection for man,—what an admirable example do we find in the dog! It is the instinct, not of individual varieties only, but of an entire race; while in these varieties we observe shades of difference, which show that the faculty is bestowed with discrimination, and with peculiar reference to man's convenience or comfort. In the elephant, too, a similar amiable property is conspicuous; and, in both orders, this remarkable propensity bears no necessary reference to feeding, or marks of regard, on the part of the master, but is free, disinterested and noble. In other tame animals, preferences to their keepers also exist;

out, while these may be equally regarded as an intended character of the inferior creation for the benefit of man, they are in general of a less generous character. Some very affecting stories are related of the deep and ardent affections of both the animals I have mentioned, which cannot be heard without emotion. We read of elephants who have defended their masters with their lives, when fallen in battle;* and we are told of dogs who have taken their station on the grave of some human friend, refusing food with the most steady resolution, till they pined to death; and of others who, during the absence of their master, became dejected and cheerless, and, on his sudden return, expired for joy.† The attachment of some of the monkey tribe to those who show them kindness is remarkable. I was myself once possessed of a monkey, of one of the smallest species, which was frequently permitted to leave its cage, and run about the grounds. Whenever he observed me at a distance, he used instantly to rush towards me, uttering cries of delight, and, if permitted, would fondly clasp his arms round my knee, or take hold of my hand and squeeze it with both his in the most affectionate manner, applying, at the same time, his lips to the back of my hand, with a motion so like that of a human being, when expressing humble but devoted attachment, as to be at once humiliating and affecting.

The instinct of local attachment is another of those qualities

* It is said of one of the soldiers of Pyrrhus, king of Epirus, that, when fighting in the territory of Argos, he fell wounded from his elephant, that noble animal rushed furiously among the combatants till he found his master, when he raised him gently from the ground with his trunk, and placing him on his tusks, carried him back to the town; and when King Porus, in a battle with Alexander the Great, met with a similar misfortune, his faithful elephant is said to have kept the enemy at bay till he had replaced the monarch on his back with his trunk; but the poor animal lost his life in this heroic defence.

† This is related of a dog belonging to the Marquis Langallery, and of several others. In the life of Mary Queen of Scots, it is stated that her favourite lap-dog, which had followed her to the scaffold, would not leave the body till forced away, and died two days afterwards of a broken heart.

by which the domestic tribes become subdued to the service of man. His home becomes theirs, and thus a bond of union is created of a very strong and important kind. This instinct of home, indeed, belongs to wild animals as well as tame, and is one of the means by which the Creator has secured the useful distribution of animals, and their limitation to their proper boundaries; but it is of great moment also in domestication, and, though beneficial in a different way, may surely be ranked among the properties intended for the purpose which it serves. Proofs of the strength of this principle are of daily occurrence. It is seen in the astonishing efforts which some animals make to return to the locality in which they have been reared, and the mysterious manner in which they find their way by unknown roads; and it is observed on a large scale, in the return of the migratory animals to the place of their birth, after wanderings of thousands of miles. The very same principle attaches the horse to its manger, the goose to its roost, and the sheep to its native hills.

This subject could easily be pursued further; and it might be shown that, in various other particulars, there is an adaptation among the lower animals to the service of man, both among those which have already been domesticated, and such as remain wild. But it seems unnecessary; and I shall conclude by observing, that there may not improbably be various other tribes of the brute creation, which, at some future period, may be destined to swell the list of animals reclaimed by the art of man, and subservient to his use. Some of the properties I have mentioned, are certainly to be found among various orders which still roam the forest, pointing them out as subjects for an experiment, which, if successful, might confer a reciprocal boon.

TWELFTH WEEK—SUNDAY.

ON THE DESTRUCTION OF THE WORLD, AND THE RENOVATION OF THE HUMAN FRAME IN A FUTURE STATE.

The more that is known of the globe on which we dwell, both as to its internal structure, and the natural processes of decay and reproduction which are continually proceeding on its surface, the more we must be struck with the mysterious nature and inconceivable extent of the changes which it has undergone, is now undergoing, and seems yet destined to undergo. Geology has unfolded to us very many unexpected facts, which all unite to prove that the crust of this planet has frequently been broken up by some mighty catastrophe, which has entirely deranged its materials, while it has submerged and destroyed all the organized existences on its surface. It has also proved, that, after these catastrophes, the One, great Creative Mind, must have exerted His amazing and incomprehensible attributes in restoring the formless chaos to beauty, order, and harmony, and in reanimating the wide waste with life and enjoyment; and that, wherever this work of renovation was carried on, the most indelible traces have been left of consummate wisdom and benevolence:—

> 'Till o'er the wreck, emerging from the storm,
> Immortal Nature lifts her changeful form,
> Mounts from her funeral-pyre on wings of flame,
> And soars and shines,—another and the same.'
>
> DARWIN.

These discoveries seem to prepare us for the arrival, at some future period, of another similar revolution; and, as it appears that each successive catastrophe has indicated continually progressive improvement in the developments of living forms, so as to exhibit a design infinite in its extent, and boundless in its duration, I cannot but think that we may, in these indications, discover an intimation, by no means obscure, of plans and preparations for the fulfilment of higher

destinies, which have for their object the final perfection and happiness of animated beings, but the precise nature of which can only be sought for in the book of revealed truth.

In looking from these indications, that we may prosecute the subject on surer ground, we find, in the record of Divine inspiration, a series of prophecies, declaring that the world, which, since the creation of man, has already been once destroyed by a universal flood, is destined again to be brought to an end; that the day will come, in which 'the heavens shall pass away with a great noise, and the elements shall melt with fervent heat, and the earth also, and the works that are therein, shall be burnt up;' but that, after this awful catastrophe, there shall arise 'a new heaven and a new earth, wherein dwelleth righteousness.'

Some intimations of a very animating character are afforded us of the nature and glorious intention of this change, as relates to the human race. The dead are to live again. Their immortal souls are, by some mysterious operation, to be reunited to their once mortal bodies: 'the sea and the grave are to give up the dead which are in them,' while those that are alive, are, 'in a moment, in the twinkling of an eye,' to be changed:—'And the Son of Man shall sit on the throne of his glory, and all the holy angels with him; and before him shall be gathered all nations, and he shall separate them one from another, as a shepherd divideth the sheep from the goats, and they shall be judged according to the deeds done in the body; the wicked shall go away into everlasting punishment, but the righteous into life eternal.'

Something of the nature of the change upon the body, which, at that great and terrible day of the Lord, is to take place, is also intimated. Like seed sown in the ground, it is buried that it may spring up from the insensible germ to a new life. But it is a life altogether different from, and superior to, that of its former state. 'It is sown a natural body; it is raised a spiritual body. The first man is of the earth, earthy; the second man is the Lord from Heaven. As is the earthy, such are they also that are earthy; and as is the heavenly, such

are they also that are heavenly; and as we have,' in this world, 'borne the image of the earthy, so shall we,' in the world to come, 'bear the image of the heavenly.'

Here a most astonishing change is intimated in the material frame of our bodies, as well as in the condition of our souls. Now, even in the circumstances of this amazing revolution, we may behold some analogy to the ordinary operations of Providence in the material world. This analogy is hinted at by St. Paul, in the passage from which I have just quoted. He compares the renovation which is to take place at the resurrection of our bodies to that which occurs to seed when sown. The change of the seed in the earth,—the germ only springing up, and the rest falling into decay,—and the production of a new plant and new grain by the Creative power of the Eternal, are beautifully and instructively compared to the springing up of a new and spiritual body from the germ of the mouldering human body which has been sown in the grave. The circumstances are different, indeed, because the catastrophe is new and unspeakably glorious; yet there is something satisfactory in the analogy, even though it be not perfect.

The reproduction of both animal and vegetable life is so mysterious and full of wonders, that whoever contemplates it wisely, will cease to think it 'a thing incredible that God should raise the dead.' In tracing the development of a plant, with its root striking into the earth, its plume bursting through the ground, its stalk ascending, its leaves and flowers expanding, its fruit forming and ripening; and much more in tracing the development of animal life, from the cicatrice to the full grown chick in the egg, and thence again, till it opens the shell and walks abroad, a living creature fearfully and wonderfully made, we behold a miracle of creative power and wisdom, not less wonderful,—though on a minute scale, and rendered familiar to us by daily observation,—than the resurrection of the human body, and its re-union with the immortal inhabitant of the once mortal tenement.

But what an amazing scene of 'glory, honour, and immortality,' does the revelation of this mighty event open to our

view. It is delightful to dwell upon it, and to trace the history of the Divine counsels with regard to fallen man. When paradise was lost, man was degraded and alienated, but not abandoned. The second Adam came, 'holy, harmless, undefiled, and separate from sinners,'—the Godhead united to humanity;—sin was expiated, and life and immortality brought to light. And now it is proclaimed that this mortal shall put on immortality, and this corruptible incorruption, and death shall be swallowed up in victory. What a new and glorious light is thus thrown on the ways of Providence, and the destiny of man! This world is our first and preparatory state:—we are here, as it were, in embryo. The seed, which is vegetating under ground, shall come forth in beauty, and shed its fragrance and its loveliness on the summer breeze; the bird, which is growing in the egg, shall rise into the light of day, and, exulting in its new being, shall soar in the liquid air, and fill the sky with its song of gladness; and thus, also, the redeemed among men shall burst from the womb of earth, and, in their new heavens and new earth, shall rejoice in the perfection and happiness of their nature. 'They shall hunger no more, neither thirst any more, neither shall the sun light on them, nor any heat; for the Lamb which is in the midst of the throne shall feed them, and lead them unto living fountains of waters; and God shall wipe away all tears from their eyes.'

'Seeing these things are so, what manner of persons ought we to be, in all holy conversation and godliness?' It is at once astonishing and mortifying to think how little mankind in general are affected by the blessed hope thus set before them, and the unspeakably important considerations connected with it; and I know nothing which more strikingly exhibits the degradation of our moral natures than the preference which is given to the paltry present over the glorious future,—to time over eternity. It argues an obtuseness of perception, a perverseness of inclination, and a meanness of spirit, which marks the depth of our fall, and which irresistibly urges upon us the necessity of seeking for aid from a Higher Power. Nor shall

we seek in vain. There is a hearer and an answerer of prayer; there is a Saviour who ever liveth to make intercession for us; there is a grace which is sufficient for us, and a strength which is made perfect in weakness.

TWELFTH WEEK—MONDAY.

FISHES.

It is not my intention to occupy much time in considering the inhabitants of the sea, which can scarcely be said to be affected materially by the seasons, as they live in an element where the sun exerts his influence less powerfully than either on the dry land or in the air, and where the changes from heat to cold are consequently less sudden. As these species of living beings, however, form a distinct apartment in the works of the Creator, and do not less remarkably exhibit his perfections than the other orders of the animal kingdom, it would be improper to pass them by, without some notice.

In reviewing the various series of animal existences, we constantly find that the simplest structures and modes of propagation are those belonging to the aquatic tribes. Among vertebrated animals, the lowest rank is occupied by *Fishes*,—a class comprehending an immense number of species, which are all inhabitants of the water, which exhibit an endless variety of forms, and which open a wide field of interesting research. We cannot fail to perceive, on the most cursory glance, the beautiful adaptation of the form and structure of all these animals to the properties of the element in which they are destined to reside In order that the fish may glide through the fluid with the least resistance, all its vital organs have been collected into a small compass, and the body has been reduced into the shape of a compact oval, compressed laterally, and tapering to a thin edge both before and behind, for the purpose of readily cleaving the water, as the fish darts forward, and also of obviating the retardation which might arise

from the reflux of the water collected behind. With the view to diminish friction as much as possible, the surface of the body has been rendered smooth, and the skin has been impregnated with oil, which, while it lubricates the animal, defends it from injurious impressions, and, at the same time, prevents the water from penetrating into its substance.

The body of a fish is nearly of the same specific gravity as the water which it inhabits, and the effect of gravity is therefore almost counterbalanced by the buoyant force of that fluid. This is not, however, precisely the case, and as the body of a fish is generally a little heavier than the fluid medium, especially if that medium be fresh water, it is necessary for the animal to keep itself in some degree of motion in order to prevent its sinking. But there is here a very peculiar structure, which has justly been remarked as one of the most singular instances that is met with of an express contrivance for a specific purpose, and of the employment of an agency of a class different from that of the mechanical powers usually resorted to for effecting the same object. Were the animal to acquire the faculty of altering at pleasure its specific gravity, it would then possess the means of rising or sinking without calling into action either the fins or the tail. Such is precisely the object of a peculiar mechanism which the Creator has provided in the interior of the body. A large bladder, filled with air, has been placed immediately under the spine, in the middle of the back, and above the centre of gravity. This is known by the name of the *air-bladder*, and is various in its form and structure in different fishes. When distended with air, it renders the whole fish specifically lighter than the surrounding water, and the animal is thus buoyed up and remains at the surface without any effort of its own. On compressing the bladder by the action of the surrounding muscles, the included air is condensed, the specific gravity of the whole body is increased, and the fish sinks to the bottom. On relaxing the same muscles, the air recovers its former dimensions, and the fish is again rendered buoyant. Dr. Roget, after describing this structure, signifi-

cantly asks, 'Can there be stronger evidence of design than the placing of this hydrostatic apparatus, acting upon philosophical principles, in the interior of the organization, for a purpose so definite and unequivocal?'

There is assuredly something exceedingly striking in the peculiarity and admirable simplicity of this contrivance, but the evidence of design is not less complete in other parts of the construction of aquatic animals. Of this kind is the nature of the external mechanism for locomotion. The principal instrument of progression is the tail; for the fins are merely auxiliary organs serving chiefly to balance the body. A fish moves in the water on the same principle as a boat is impelled in sculling or paddling, by striking rapidly with the tail alternately to the right and left. Every part of the body is calculated to promote the execution of this motion. The principal muscular strength is bestowed on the movements of the tail, and the most powerful muscles are those which give the lateral strokes just mentioned. For the same purpose the most important intestines are placed forwards, and crowded towards the head. There is no neck; and the abdomen may be considered as immediately adjoining the head, the organs of respiration being placed rather below than behind the latter members. It is thus that scope has been given to the vertebræ connected with the motion of the tail, which compose more than half the bulk of the animal.

The construction above described is so admirably suited for its purpose, that most fishes glide through the water with the utmost rapidity, and with scarcely any visible effort, performing long journeys with no apparent fatigue. The salmon has been known to move at the rate of nearly four hundred miles a day, for many days together. Sharks often follow ships across the atlantic, not only outstripping them in their swiftest sailing, but playing round them on every side just as if the vessels were at rest.*

* Roget's Bridgewater Treatise, vol. i. pp. 408, 434.

Every thing about a fish is peculiar and specially adapted to the element in which it moves,—the mouth, the gills, the fins, the circulation of the blood, the light and elastic gristle of the bones, the various organs of sense; and each in its kind forms a demonstration of consummate wisdom in the Divine Contriver. But I must not pursue the enticing subject further, and shall conclude with a striking passage from Mr. Kirby's Bridgewater Treatise, in which he compares the tenants of the water with those of the air.

'When we sum up all the diagnostics of the class we are considering, we can trace at every step, so that almost *he that runs may read*, infinite power in the construction, infinite wisdom in the contrivance and adaptations, and infinite goodness in the end and object of all the various physical laws, and in all the structures and organizations by which they are severally executed, which strike the inquiring mind in this globe of ours. What else could have peopled the water and the air with a set of beings, so perfectly and beautifully in contrast with each other, as the fishes and the birds? Sprung originally from the same element, they each move, as it were, in an ocean of their own, and by the aid of similar, though not the same, means. The grosser element they inhabit required a different set of organs to defend, to propel, and guide, and to sink and elevate the *fish*, from what were requisite to effect the same purposes for the *bird*, which moves in a rarer and purer medium. Yet, as both were fluid mediums, consisting of the same elements, though differently combined, analogous organs, though differing in substance, structure, and number, were required. For what difference is there between swimming and flying, except the element in which these motions take place? The fish may be said to fly in the water, and the bird to swim in the air; but perhaps the movements of the aquatic animal, from its greater flexibility and the number of its motive organs, is more graceful and elegant than those of the aerial. The feathers of the one are analogous to the scales of the other; the wings to the

pectoral fins; and the tail of both acts the part of a rudder, by which each steers itself through the waves of its own element.'*

TWELFTH WEEK—TUESDAY.

MAN.—HIS EXTERNAL STRUCTURE.

Cicero, who not only joined the qualities of a profound philosopher to those of an accomplished orator, but who is entitled to the still higher praise of cherishing, so far as his opportunities admitted, enlightened and deep-felt views of religion in the midst of heathenism and profligacy, gives a striking description of the human body, which, although in the present day, when his statements have become familiar, it may appear less original and striking than it must have been when first published, proves that he was nobly alive to the wonders of Creative Intelligence. The passage is as follows:—

'To what has been said of the incessant and ingenious foresight with which Nature acts, many things may be added, to show how abundant and how valuable are the bounties which have been bestowed on men by the Deity; who, first of all, has formed them elevated above the earth, lofty and erect, that with an eye directed to heaven, they might aspire to the knowledge of the Divine character.† For men are placed upon earth, not as mere inhabitants and possessors of the soil, but as spectators of spiritual and heavenly things, a power which no other animal possesses.

* Kirby's Bridgewater Treatise, vol. ii. pp. 375, 376.

† Ovid expresses the same sentiment in a well-known passage of his Metamorphoses:—

> Pronaque dum spectant animalia cætera terram.
> Os homini sublimi dedit: cœlumque tueri
> Jussit, et erectos ad sidera tollere vultus.
>
> *Met. Lib.* I. *v.* 84.

'With respect to the senses, by which exterior objects are conveyed to the knowledge of the soul; their structure corresponds wonderfully with their destination, and they have their seat in the head, as in a citadel. The eyes like sentinels, occupy the most elevated place, whence, on discovering objects, they may give the alarm. An eminent station was suitable to the ears, because they are destined to receive sounds, which naturally ascend. The nostrils required a similar situation, because odours likewise ascend, and it was necessary that they should be near the mouth, through which nature gives a passage to solids and to liquids. As for touch, it is diffused, generally over the whole body, that we might neither receive any impression nor be attacked by cold or heat without feeling it.* * * * * * * *

'But what other artist than Nature, whose dexterity is incomparable, could have formed our senses with such exquisite skill? She has covered the eyes with very delicate tunics, transparent before, that we might see through them, and close in their texture, to keep these organs of vision in their proper situation. She has made them smooth and moveable, to enable them to avoid every thing by which they might be injured, and to look with facility to whatever side may be necessary. The pupil, through which the impressions that constitute the faculty of sight are received, is so small, that it readily escapes from every object capable of doing it mischief. The eyelids, which serve as coverings to the eye, have a soft and polished surface, that they may pass over them without pain. Whether the fear of some injury obliges us to shut them, or we choose to open them, the eyelids are formed in such a manner, as to adapt themselves to either of these motions, which is performed instantaneously. They are, if we may so express it, fortified with palisades of hair, which serve

* The Roman orator here adds a sentence, which, though equally true and striking with the rest, might, if translated, somewhat shock the fastidiousness of modern taste. 'Ut, in ædificiis, architecti avertunt ab oculis et naribus dominorum ea, quæ profluentia necessario tetri essent aliquid habitura; sic natura res similes procul amandavit a sensibus.'

to repel whatever would attack the eyes when they are open, and to defend the place where the eyelids join, when sleep has closed them and rendered them of no use to us. Our eyes possess the additional advantage of being surrounded and defended by eminences; for, on the one hand, to stop the perspiration that trickles down from the head and forehead, they have projecting eyebrows; and, on the other, to preserve them from below, they have cheek-bones, which likewise advance a little. The nose is placed between both, like a partition wall.

'With respect to the ear, it remains continually open, because we have occasion for its services, even when asleep. If any harsh sound then strikes it we are awaked. It has winding channels, lest if they were straight and level, any object might introduce itself into them.

'And then our hands, how convenient are they, and how useful to the arts! The fingers are extended or contracted without the least difficulty, so extremely flexible are their joints. With their assistance, the hands use the pencil and the chisel,—they play on the lyre and on the lute. So much for the elegant accomplishments; and as to the necessary arts, they cultivate the earth, build houses, manufacture stuffs, make clothes and utensils of copper and iron. The imagination invents,—the senses examine,—the hand executes. So that if we are lodged, clothed, and sheltered; if we have cities, walls, habitations, temples, it is to our hands that we are indebted for all these.'*

Modern science has greatly increased the force of the Roman orator's reasoning, by its anatomical and philosophical discoveries; for the deeper we penetrate into the secrets of Nature, the more wonderful are the evidences we find of the

* De Natura Deorum, lib. ii. Cicero is not singular among the ancients, in adducing the construction of the human body as a proof of Divine skill. Aristotle, in combating the philosophy of Anaxagoras, says, that man is not superior to the brutes because he has hands, but that he has hands because he is superior to the brutes; and Plato speaks of the structure of the human frame as an evidence of Creative Wisdom.

Divine perfections; but it is pleasing to observe an accomplished mind emerging from surrounding darkness, and employing its enlarged faculties in contemplating, with becoming gratitude, the wisdom and beneficence of the Creator.

The structure of the human body has been a subject of admiration to all who have even cursorily examined it, and nothing seems better calculated to silence atheism, than the labours of the anatomist. The anecdote of the ancient sceptic, on whose mind conviction flashed while examining the construction of the human heel, is well known. In modern times, Nieuwentyt, Ray, Paley, and others, have drawn many unanswerable arguments from this source; and Galen, at a more distant period, in the midst of an anatomical analysis of the human frame, gave vent to his admiration in words which, though those of a heathen, would have done honour to the piety of a Christian:—

'O Thou who hast made us! in composing a discourse so sacred, I think I am chanting a hymn to thy glory. I honour thee more by unfolding the beauty of thy works, than by sacrificing to thee whole hecatombs of bulls, or by burning in thy temples the most precious incense. True piety consists in first learning myself to know, and then in teaching others, the greatness of thy bounty, thy power, and thy wisdom. Thy bounty is manifested in the equal distribution of thy presents, having allotted to each man the organs which are necessary for him; thy wisdom is seen in the excellence of thy gifts, and thy power is displayed in the execution of thy designs.'*

* Galen de Usu Part. lib. iii. cap. 10. This eminent and virtuous man, who lived in the second century, is supposed by some to have died a Christian.

TWELFTH WEEK—WEDNESDAY.

MAN.—HIS INTELLECTUAL POWERS.

The mental powers of man are suitable to his physical condition. He has instincts, but these are not equal in the human race to those of the brutes, because he is invested with a higher principle, which supersedes them. In him alone, of all the visible creation, is the faculty of reason fully developed. The lower animals, it is true, possess qualities which approach this high property, and which cannot easily be distinguished from it by a definition; but if theirs may be called reason, it is not *human* reason. It wants, even in its nearest approaches, the freedom, the comprehensiveness, the grasp of human intellect, although this faculty be in the brute cultivated to its utmost extent, and in the man be suffered to exist without improvement. A dog or an elephant may display a surprising sagacity in one or two directions; but man is endowed with a sagacity of a superior order in all directions. And then, if we speak of his capacity for improvement, how infinitely superior is he to every other order of the animal creation! Compare a Newton, a Locke, or a Bacon, with a savage of Australia, and the amazing capability of expansion in the human mind will be at once perceived.

This leads me to notice a peculiar intention of the Creator with regard to the human race,—I allude to that of intellectual discipline. Every thing seems to be contrived and adapted to this great object. His situation in reference to the external world, whether we consider animate or inanimate nature; the alternations of the seasons; the germination, the growth, and the decay of plants; the various faculties and dispositions of living beings; and especially the power bestowed on him of appropriating organized as well as unorganized existences to his use,—to alter the form or qualities of one class, and to modify the functions and instincts of another, so as to make them subservient to his will and productive of his advantage;—all

these indicate very distinctly the intention of the Creator, and point to the development and the training of the human faculties, as one great end for which man was stationed in this lower world.

Nor is this relation in which man stands to his own species a less striking indication of the same truth. I have already noticed in this light the remarkable arrangement by which man is placed in families, and the child, by slow degrees, advances through the various stages of infancy, boyhood, and youth, to the full vigour and maturity of his faculties; * but all the relations of society speak a similar language. It is by the mutual intercourse, transactions, and arrangements of social life, its sympathies and emulations, its wants and desires, its very hatreds and contentions, that the human mind is strengthened, enlarged, and exalted, till its intellectual powers rise to so stupendous a height, and become able to survey so wide a field.

Now, the adaptations of man's physical and mental faculties to this peculiar state are very remarkable. Of his bodily powers I have already spoken, and, in the quotation from Cicero, the hand was particularly mentioned. This wonderful instrument, in conjunction with the arm, may be regarded as the perfection of mechanical power, consisting in a combination of strength, with variety and extent of motion, and with a nicety of touch, which conveys to the mind definite ideas of the figure, of the hardness, and of the consistency of bodies. Although the superiority of man is assuredly not owing, to Anaxagoras maintained, to the possession of a hand, yet, without it, he would be comparatively powerless. He would want the means of effecting what his ingenuity might suggest; and his ingenuity itself would be kept in abeyance by that very want. 'This,' says Mr. Turner, 'is the sceptre of his power, his instrument of domination, his all-conquering and all-transcending mechanism. It has all the potentiality of an enchanter's rod, and has achieved those wonders of human art, strength, and ingenuity, which the magicians of our imagination might toil in vain to surpass. We have not the eagle's talons or the

* See 'Spring,'—Papers on the effects of protracted childhood.

lion's claws at the end of our fingers; but we can arm them with swords, guns, and bayonets, far more terrible. All that we admire, and dread, and use, in mechanism and manufacture, in art, war, luxury, labour, and comfort, is the produce of the human hand.' *

This admirable instrument, however, would be of little benefit without the informing and directing mind. It is still but an instrument; and one of the irrefragable evidences of Creative contrivance and adaptation, is the gift of such an instrument to the only being possessed of a reasoning and intelligent soul. There is no other terrestrial animal on whom it would not have been bestowed in a great measure in vain.

It is not my intention to enter into any formal analysis of the intellectual powers; but it is impossible not to perceive that the correspondence between these and the structure of the human frame is exceedingly remarkable. Man has appetites, passions, and affections, which incite him to act; he has ingenuity and judgment to enable him to contrive and to resolve; and, by the instrumentality of his bodily powers, he finds ability to execute. To these faculties and inclinations the external world is adapted. He has stone, wood, and iron at his command. With these materials, he builds houses, constructs machinery, bridges rivers, traverses the sea in ships, and overleaps the barriers which set bounds to his habitation, and circumscribe his intercourse with his fellows. He does more. By the aid of an element, whose properties were unknown to early ages, he finds himself possessed of an agent of tremendous force, and his genius is again roused. He invents new and more complicated forms of mechanism, by which manufactures are improved and extended, commerce is promoted, and vessels are impelled through the ocean against wind and tide, while carriages career on land at a speed which emulates the velocity of the eagle, and seems almost destined to annihilate the obstructions of time and space, and to unite, as in one great city, the whole scattered inhabitants of the earth.

* Sacred History of the World, vol. i. p. 509.

Meanwhile, the lower animals yield to the sway of man subdued not by his physical force, for in this he is inferior to many, but by his mental skill. He destroys the noxious, he cherishes the useful and subservient; he extends his plastic hand over the earth, and, causing the desert to blossom as the rose, multiplies the numbers both of his own species and of the animals he has subdued to his service. Hence, again, proceed new inventions and new triumphs. The very elements bend to his control. The rigours of winter are softened; the breath of spring becomes more balmy; summer is decked in fresh charms; and autumn teems with additional plenty. Doubtless there are bounds to all these acquisitions; yet it is not man who shall prescribe them, but the fiat of the Deity himself.

TWELFTH WEEK.—THURSDAY.

MAN.—HIS MORAL POWERS.

'In man,' says Voltaire, 'there is more wretchedness than in all the other animals put together. He loves life, yet he knows that he must die. If he enjoys a transient good, he suffers various evils, and is at last devoured by worms. This knowledge is his fatal prerogative; other animals have it not. He spends the transient moments of his existence in diffusing the miseries which he suffers, in cutting the throats of his fellow creatures for pay; in cheating and being cheated; in robbing and being robbed; in serving that he may command; and in repenting of all that he does. The bulk of mankind are nothing more than a crowd of wretches equally criminal and unfortunate; and the globe contains rather carcasses than men. I tremble at the review of this frightful picture, to find that it contains a complaint against Providence itself; and I wish I had never been born.'

In this picture there is a certain horrid verisimilitude, though it is darkened and deformed by the bitterness of the misan

thropist, and the impiety of the atheist. It is not with the moral powers of man as with his intellectual. He has lost the image of God which was originally stamped on his soul; and as regards his moral nature, is launched on the ocean of life, a ship at the mercy of every wind and current, without a rudder and without a pilot. He does not, therefore, improve in purity and virtue by the discipline of life as he does in mental capacity. On the contrary, his progress in morals seems to be retrograde as his intellectual faculties expand by exercise; and, by the intercourse of society, he becomes more regardless, more depraved, more impious. His love of evil increases along with his power of perpetrating it; and, if left to himself, he at last exhibits a spectacle little different from that which the infidel Voltaire has portrayed with so ruthless a hand. The Apostle Paul describes the inhabitants of the heathen world, in his day, in terms scarcely less painful:—'As they did not like to retain God in their knowledge,' says he, 'God gave them over to a reprobate mind, to do those things which are not convenient; being filled with all unrighteousness, fornication, wickedness, covetousness, maliciousness; full of envy, murder, debate, deceit, malignity; whisperers, backbiters, haters of God, despiteful, proud, boasters, inventors of evil things, disobedient to parents, without understanding, covenant breakers, without natural affection, implacable, unmerciful: who, knowing the judgment of God, that they which commit such things are worthy of death, not only do the same, but have pleasure in them that do them.'*

This is assuredly no rhetorical and misanthropic picture like that with which I commenced this paper, but a simple statement of the condition of heathen society in the days of the apostle. The arts and sciences had increased beyond all precedent in the empires of Greece and Rome, and moral depravity had kept pace with intellectual acquirements. To this melancholy fact history bears witness; and the description of the state of manners in Rome, by historians almost

* Romans i. 28, 29.

contemporary with Paul, corresponds but too truly with that which I have quoted.*

The truth and depth of observation with which some heathen philosophers speak of the depravity of the human heart, cannot be contemplated without wonder, as the profundity of their views seems to be such as was scarcely attainable by the unilluminated intellect of man. Plato in particular speaks of original sin with an accuracy little short of an enlightened Christian. 'The Divine nature,' says he, 'originally invigorated the human soul; but, when this was alloyed, humanity came to be reduced to the present standard, to the corruption and degradation of the human race; and from that fountain have flowed all the evils of mankind.'†

This sentiment he repeats in various forms of expression in different passages of his works; and what is not less worthy of remark, he seems to have penetrated still deeper into this great mystery, and darkly, indeed, but not doubtfully, to have looked forward to the remedy which the Divine wisdom had provided. 'God, the parent and author of this system,' observes that remarkable genius, 'beholding the world placed in this calamitous situation, and resolving that it should not be entirely destroyed by the disorder into which it was thrown, again seizes the helm, and carefully guides it, that he may unite its loosened, and as it were incongruous, materials; and restoring them to their original order, may finally adorn and improve them.'‡

There is something very striking in the discovery of these sentiments in a heathen philosopher; and if we are not to be-

* See Sallustii Bell. Catil. cap. 12, 13. The language of Sallust coincides very remarkably with that of the apostle. 'Ex divitiis juventutem luxuria atque avaritia cum superbia invasere; rapere, consumere; sua parvi pendere, aliena cupere; pudorem, pudicitiam, divina atque humana promiscua, nihil pensi, atque moderati habere.' 'Sed lubido stupri gancæ, ceterique cultus non minor incesserat:—viros pati muliebria, mulieris pudicitiam in propatulo habere: vescendi causa terra marique omnia exquirere,' &c. &c.

† Plata in Critia, pp. 106 and 121.

‡ Plato Politic. p. 251, in argument.

lieve that in some unknown way they derive their origin from revealed truth, they at all events show the gigantic efforts of human reason struggling with a mysterious subject, which it in vain attempts fully to grasp.

Shall we then say, with the atheist, that 'the frightful picture,' which he draws, 'contains a complaint against Providence?' God forbid! Let us examine this matter calmly, with the aid of that light which comes down from heaven. If we ask, Why, under the government of a holy God, the moral powers of man are in a state of disorder, while his intellectual faculties are vigorous and active? this question, so full of mystery, can only be answered by God himself. And he has answered it. He tells us that he made man upright but free, and that by abusing this freedom he fell, and in his fall shook the world to its centre, blighted the face of nature, and changed the character and destiny of all living things. If, again, it be asked, Why man was permitted to fall? or having fallen, why he was permitted to exist for a moment in a world which he had polluted, and to flourish under the sustaining hand of the Creator, against whom he had dared to rebel? here once more the mystery is solved by revelation, and a scheme of mercy and grace is unfolded, which displays the character of God in the most awful indeed, but, at the same time, in the most glorious and endearing light.

In this scheme not only are the power and wisdom of the Eternal presented to us in a new and astonishing point of view, but new attributes of the Divine nature appear, in contemplating which the soul is lost in wonder, love, and gratitude. The fallen race of Adam were permitted to live, that, under the moral government of the Son of God, and through the influences of his Spirit, the ruin of the fall might be repaired; that evil might become the parent of good; that folly, taught by experience, might be made the handmaid of wisdom; that sin, when chastised, might issue in holiness; and that the long train of disappointments and sufferings, diseases and deaths, might pave the way which should lead the humbled but penitent sinner to glory, honour, and immortality.

Strange but glorious plan! In sinful man is realized a scheme of divine government as far surpassing the previous conceptions of short sighted humanity as east is distant from the west,—as heaven is higher than the earth. What human wisdom could have conceived a system of grace to sinners, founded on the long-suffering mercy of a just and holy God, in which *Satan* himself should be employed as a teacher of righteousness, in which the King of Terrors should be converted into a messenger of joy, and in which God should be just while he is the justifier of the ungodly?

How awful! how mysterious! yet how full of beauty and of grace is the God of revelation! His way is in the sea, his path is in the great waters, and his footsteps are not known. But it is enough for us to be assured that he is the Lord God, merciful and gracious, long-suffering, and slow to anger; who takes no pleasure in the death of sinners, but rather that they should turn from their iniquities and live; who is in Christ Jesus, reconciling the world unto himself, and not imputing unto men their trespasses.

I say nothing at present of the unhappy state of those who go down to the grave without hope. They are in the hand of God; and it is not for mortal man to withdraw the veil in which this awful subject is involved. Doubtless the Judge of all the earth does right; but there are some things connected with the existence of evil which seem destined not to be revealed on this side of the grave. To our awakened sight the light poured on these mysteries, we may well believe, will form a theme for new admiration and praise throughout the ages of eternity.

Meanwhile, let us take comfort in the declarations of the revealed word. These promises are to us and to our children. This is not the history of God's dealings with another world, but with the world in which we live; it is not an account of grace and mercy to another guilty race, but to the very race to which we belong; nor is it to other individuals of that race only that these inestimable blessings are offered, but to ourselves. If we will accept of the offered salvation, we are

included in that history—the objects of that grace and mercy —the partakers of these inestimable blessings. What manner of persons then ought we to be?

TWELFTH WEEK—FRIDAY.

MAN.—PHYSICAL EFFECTS OF CLIMATE.

That the whole human race is originally derived from a common parent, must be admitted by all who acknowledge the authority of Scripture, although there have been some daring speculators, who, not more contrary to the dictates of Revelation, than sound philosophy, have attempted to maintain an opposite opinion. Whence, then, the varieties of the human race, so remarkable, especially in three great branches, distinguished by their colour into the fair, the yellow, and the black; or, by their aboriginal habitation, into the Caucasian, the Mangolian, and the Ethiopian tribes?

This question cannot be answered satisfactorily in a few words. Nevertheless, there are some well known facts, the mere mention of which may serve to allay the surprise at first excited by the contemplation of these varieties, and may tend to show how consistent such variations are with the physical laws which pervade organized existence. The changes which are naturally effected by cultivation, in the appearance and qualities both of the plants and animals which have been subjected to the influence of man; the effect which a peculiar quality or conformation accidentally occurring in the parent produces in the offspring, frequently observable for many generations; and especially the influence of food and climate on the physical constitution,—seem of themselves quite sufficient to account for the remarkable varieties which the human frame exhibits in its different branches. It is to the latter effect that I intend at present to confine my attention.

One remarkable effect of a warm climate is to darken the skin. That this results from the heat of the intense rays

of the sun, may be fairly inferred, not only from the fact that we find the inhabitants of the tropics, without exception, of a complexion more or less dark, but also from another, and perhaps a more convincing fact, that the descendants of Europeans, when transported to the equatorial regions, assume the black tint after the lapse of some generations. This is strikingly exemplified in the case of a colony of Jews, discovered in the Indian peninsula. Now, that this is a wise provision, we might safely conclude, without direct proof, from what we know of the provisions and accommodations of nature in other cases: But the philosophical principle can be assigned. It is true that a black colour, as I have elsewhere observed, absorbs the heat more readily than a white; and, therefore, if this were the only thing to be attended to, one would expect the complexion of the human body to be reversed in its locality, the purest white being found where the rays of the sun were most powerful, and the darkest in the regions verging towards the poles. But there is another principle which the progress of chemical science has very recently elicited, and which most satisfactorily accounts for the arrangement; it is this,—that a dark surface radiates heat much more readily than a surface of white. Now, the chief source of heat in a living body, is not the external atmosphere, or the rays of the sun, but the animal warmth as it is called, that is, the heat generated inwardly, by some hitherto obscure chemical process in the blood. It is of more importance to the comfort and health of the frame, that this internal source of temperature should be properly regulated than that which is external; and this is the provision which the wisdom of the Creator has actually adopted. In the colder regions, the fairness of the skin prevents the escape of the animal warmth; and in the warmer, a dark colour is superinduced, that the same warmth may freely escape, thus compensating, in some degree, by this remarkable contrivance, for the differences in climate. The same principle operates, indeed, to a certain extent, even in temperate climates, where exposure to the summer's sun is well known to darken the complexion, an effect which the return of winter removes.

Another peculiarity induced by climate, is a difference in the freedom and extent of the perspiration which serves also to modify the heat of the body. In the warmer climates, the pores are comparatively open, and the perspiration issuing freely, carries off from the frame the superabundant caloric, and at the same time bedews the body with a moisture which, in its evaporation, contributes not a little to create an agreeable coolness. But, besides this, there is a remarkable quality in the human body which enables it to resist the application of even high degrees of heat. This has been proved by various interesting recent experiments; and it is on this principle, that some individuals have astonished the public by the exhibition of their power of existing in an oven, or an apartment, heated to such a considerable extent, as to roast the flesh which has been placed by their side. A similar power exists in the living frame, as regards cold; and, in both instances, habit produces an extraordinary accommodation on individuals long resident in a particular climate, and still more in their progeny after the lapse of some generations.

In another particular, there is an adaptation to heat of climate, of which St. Pierre, alluding to the Negro race who inhabit Africa, the hottest region of the globe, thus writes:—'Nature has covered the head of these careless and unindustrious tribes with a fleece more crisp than a tissue of wool, which effectually shelters it from the burning heat of the sun. They are so perfectly sensible of its accommodation to this purpose, that they never employ a substitute head-dress; and there is no description of mankind among whom artificial coverings, as bonnets, turbans, hats, &c., are more rare than among the Negroes. They use such as are foreign to them merely as objects of vanity and luxury; and I do not know of any one that is peculiar to their nation. The inhabitants of the peninsula of India are as black as they; but their turbans communicate to the hair, which, but for their head-dress, would perhaps be frizzled, the facility of growing and expanding.'*

* Studies of Nature (Hunter's Translation), vol. ii. p. 4.

But the chief physical effect produced by heat of climate, is that of relaxing the human frame, and making it less capable of exertion ; and it is very remarkable, as an instance of accommodation to circumstances, that, where this unbracing effect is produced, nature is most liberal in her distribution of esculent plants and fruits ; as if it were intended, by this profusion, to compensate for the want of energy in the human constitution. Hence also a moral effect is combined with what is purely physical, the nature of which will fall to be mentioned in the following paper.

TWELFTH WEEK—SATURDAY.

MAN.—MORAL EFFECTS OF CLIMATE.

That some effects of a moral as well as of a physical nature are produced on the human family, by differences of climate, can scarcely be doubted, though these effects are probably less marked than has frequently been alleged. That sloth, effeminacy, and a tendency to the excessive indulgences of sense, are more remarkably characteristic of the voluptuous regions of the tropics, than of those of sterner aspect, which verge towards the poles, is very generally admitted ; and that this difference arises from causes partly physical, and partly mental, can scarcely be called in question.

It is not to be doubted, that a hot temperature of the atmosphere tends to enervate the human body ; and it is possible, too, that a similar state of the climate may have some effect in exciting the passions, so far as these are of a physical nature ; but if this influence were as powerful as has been alleged, it would be much more uniform and permanent than history proves it to be. The abject Greeks and Romans of the present day, how utterly unlike are they to their predecessors of the ancient world ! Yet the climate of these classic regions, though there is reason to believe it has been in some respects altered by the progress of agricultural improvement

in the adjoining continent, is not so different from its former state, as to make any important alteration in the physical state of the human body.

Moral effects, however, are not of so fixed and permanent a nature as physical; they depend on more numerous combinations, and circumstances of a more arbitrary nature; and it is to these chiefly that we are to look for the character produced in man by climate.

The effect of climate in raising an exuberant supply of the necessaries of life, has already been frequently alluded to. This of itself is calculated to create a very marked difference in the human character, and may, without having recourse to any other cause, account for much of the difference which subsists between the inhabitants of these regions, and those of climates where nature is less bountiful. Abundance gives rise to indolent and luxurious habits, while privation renders men hardy, intelligent, and adventurous. But this is a moral effect, although it arises from a physical cause. We can now understand why a nation may, at one time, be vigorous, enterprising, and enlightened, and at another sunk in sloth and barbarism, although nurtured in the same climate, and subjected to the same influences of the seasons. The moral causes may be changed. There may be abundance where there was formerly want, and hence a stimulus to exertion may be removed; or an oppressive despotism may have so ground the faces of the people, that they have ceased to possess the moral aspect of free-born men, while they retain all the vigour of their bodily powers.

But there are other causes originating in climate, which operate no less certainly and effectually in producing a moral influence on the minds of men. Among these may be mentioned the alternations of the seasons, which differ in their intensity in different countries, and thus produce a considerable effect in forming what has been called a national character. This may be illustrated by contrasting the character of the French nation, for example, with that of their neighbours in Britain. There is, doubtless, much in this difference of char

acter which arises from the insular locality of the one, and the continental situation of the other. It is to the diversity of condition now alluded to, that we may fairly attribute the warlike propensities of the Gallic nation, and the commercial spirit of the British ; and not less, perhaps, the free institutions of the latter, which have for centuries fostered the spirit of inquiry, of enlightened enterprise, and of improvement in all the departments of life. But in comparing the character of the French nation with that of our own country, there is one striking trait, which seems to depend, almost entirely, on difference of climate. I allude to the deficiency of the former in domestic habits. In Britain, our changeable climate, and the long evenings of autumn, winter, and spring, confine the inhabitants much to their homes. There they acquire habits of social intercourse, and of sober reflection. The ties of husband and wife, off parent and child, o brother and sister, are drawn closer as they surround the family fireside, and unbend their minds, or indulge their affections, or communicate mutual instruction. They study, they converse, they join in innocent amusements ; and haply a higher theme occupies their attention, which raises their attachments above earthly things, and gives them the 'rivet of eternity.'

Habits thus formed become permanent, and are extended to all the transactions of life. The employments of summer partake of the qualities impressed on those of the other seasons of the year ; and the pleasures of home, with which so many pure and elevating,—I had almost said holy,—principles are associated, and on which so many valuable habits depend, have thus become part of the national character. The inhabitants build villas; they tastefully adorn their grounds ; they cultivate their gardens; they surround their houses with comforts, with conveniences, with luxuries; and all these labours are only external indications of the deep-rooted love of home which has taken possession of their hearts. Hence the natives of our favoured island are, in comparison with those of the neighbouring country, affectionate, social, contemplative ; and, may I not add, what is far

nigher praise, virtuous and charitable, enlightened and religious?

Our Scottish bard, speaking of the cultivation of the domestic virtues, in humble life, which he had so beautifully portrayed in his 'Cottar's Saturday night,' says truly,

> 'From scenes like these, old Scotia's grandeur springs,
> Which makes her loved at home, revered abroad;'—

and happily it is not to humble life alone, nor to the people of Scotland, that these virtues are confined. They are every where intimately associated with the employments and relaxations of the middle classes, and shed respectability and value on the character of the highest ranks in the land.

In France, on the other hand, and more especially in her southern provinces, the weather is much more steady and equable during all the seasons of the year, affording free opportunity for exercise in the open air. In that delightful climate the inhabitants can very generally move abroad in every part of the day; and the evenings, when the family circle might meet together for the enjoyment of domestic charities, are comparatively short. There is little time, therefore, for the formation of that character which depends on the intercourse of the family circle; and the consequence is, that for domestic comfort they are even destitute of a word in their language. They know nothing of that simple neatness which adorns our cottage gardens and the dwellings of our farmers, nor of those elegancies of domestic taste among the higher ranks, which have given rise to what has emphatically been called English gardening. The houses of their peasantry, and the chateaus of their gentry, are equally devoid of that air of snugness, convenience, and accommodation, which forms so striking a feature in an English landscape. In truth they do not cultivate that domestic intercourse which constitutes so much of the happiness of life among us. It is not at home, but in the sports of the field, or in the bustle of society, or in the excitements of theatrical exhibitions, that they spend their hours of relaxation. It is there that they live and breathe and

receive enjoyment. The effect of all this is strongly indicated in their character. They are ingenious but frivolous, sprightly but heartless; creatures of impulse and excitement, but void of depth and sincerity; or if they apply their minds to study, they are acute and inventive, discursive or philosophical, sometimes indeed excelling in the highest departments of intellect, but seldom sober-minded, moral, and pious. It is the fault of their education, originating in an abuse of that beautiful climate which was bestowed on them for a blessing, and may yet, in better times, be employed in a manner more conformable to the high ends of human existence.

Were we in like manner to examine the circumstances which, in other countries, give rise to national character or serve to modify it, we might probably find that the moral influence of climate forms almost every where one of its constituent elements. But enough has already been said to show the connexion which it has pleased the Creator to institute between mind and matter, even in things which, at first sight, may seem remote and uninfluential; and to afford us a glimpse into that complicated and admirable, but sometimes recondite machinery, by which the moral discipline of the world is conducted.

THIRTEENTH WEEK—SUNDAY.

CONFUSION OF TONGUES.

'God is not the author of confusion but of peace.' So do the holy oracles affirm. Any one who has fixed his mind on the ordering of the seasons; the diurnal and nocturnal succession; the invisible but unvarying law, 'which hath placed the sand for the bound of the sea, by a perpetual decree that it cannot pass it—and, though the waves thereof toss themselves, yet can they not prevail; though they roar, yet can they not pass over it,'—any such person must own that

the God of *Nature* is the God of order. Again, who that has marked the regularity with which the fertile earth gives forth her returns to the husbandman; how the hand of the diligent maketh rich; how the habits of the temperate and abstemious procure sanity of the bodily and mental constitution,—but must own that the God of *Providence* smiles benignly on the observance of order in his creatures. Or, should we study the minute directions condescendingly given to the children of Abraham, when they had escaped from the misrule and severities of Egypt, and knew not how to arrange their journeyings in the wilderness; should we mark the rules by which they struck and carried the tents, and how each tribe had its locality fixed in the order of march; and how each had its camp and distinguishing standard attached to it, with the ensign of his father's house; and how the station of the Levites was divinely appointed round about the tabernacle of the testimony; and how their time to march, or to convene, either in whole congregations, or only in a council of the princes, was commanded to be guided by the varied signals of two silver trumpets;—should we study these things, will not irrefragable proof be furnished, that the God of Revelation is the God of order?

On looking abroad through creation, however, we are arrested by many tokens of confusion: we see hills, which might have been covered with smiling flocks, broken into unproductive precipices; streams which might have irrigated many a meadow, foaming along in limited and rocky channels; nations, which might have been united in one extended continent, cut up and dissevered by many a league of ocean; limbs, formed with evident design to sustain frames which are rendered helpless without them, distorted and withered;—delicate organs, constituted to convey the delights of sound and vision, rendered tuneless and sightless; and—O still deeper profundity of frustrated purpose and averted design!—affections, calculated to sweeten and alleviate—souls capable of deep emotion and noble enjoyment—perverted into the very gall and wormwood of the cup of life, degrading him

who owns them, and dishonouring the God they are capable of glorifying.

The student of revelation, and the student of his own heart, will alike readily admit, that much of this confusion is not accidental—is not the result of mistake or misrule, but the necessary and irreversible result of man's moral departure from conformity to the image and will of the God of order;—a state of things bound fast in the laws of the Holy One, whose mind and will terminate in the most beautiful consistency and correctness: and, therefore, whose mind and will cannot be contravened, without producing a confusion from which all the perpetrators of that contravention must suffer, though it can in no wise touch or approach unto Him who inhabiteth the praises of eternity.

Amongst the confusions which are most prominent, and which to the learned, or to the expanded mind, are most incommodious, is the diversity of speech which the nations of our world experience. Let the native travel but to the summit of his mountain, or cross some rill which, in its insignificance, forms no barrier to intercourse, and he shall find the dwellers on the other side as barbarians to him. Each possesses the curious and ingenious structure, which constitutes the complex organs of speech; each experiences the wants which would render communication a great convenience; each inherits the social temperament, which would spring forth into converse;—but, with all these appliances, they can hold no intercourse. Their tongues are diverse, and from that springs a sentiment of distrust and suspicion, often productive of enmity. Let the man of research seek to profit by the wisdom of other ages; open to him libraries rich in the lore of ancient philosophers,—he encounters a barrier which sends him back to his hornbook; and, instead of attaining the knowledge after which he pants, he must defer his thirst for a year, it may be, or a far more extended portion of his brief span, and resume his Lexicon, and Grammar, and school-boy habits. Let the Christian philanthropist overcome his love of ease, break the ties of home and country, sever

himself from the communion of the Church, and traverse oceans to reach a land where he purposes to proclaim, that the kingdom of Heaven is come;—his zeal is restrained, his hopes are deferred, the object of his mission is forced into the back-ground, while his powers are all applied to the tedious process of acquiring an unknown tongue. When at last he would emerge from behind this formidable and discouraging obstacle, and tell of the Saviour on whom his own hopes are set, he does not proclaim with freedom and courage the ac ceptable year of the Lord. No; his message is delivered in the dubious lispings of childhood; peradventure his imperfect acquisition leads him to utter that which he meaneth not, and, almost certainly, he exposes himself to the ridicule of those whom he would gladly teach.

Truly had the people been one, and had they possessed all one language, 'nothing would have been restrained from them that they had imagined to do.' But fallen man was not worthy to have such a gift confided to him. He proved this by trying the impious project of raising himself a name, whose foundation was laid in his pride, instead of exalting the name of his God and Redeemer, the foundation of whose kingdom is laid in man's humility. He forsook the true God, and set up self as his idol, and sought to raise a tower to heaven, which should be as a uniting altar, lest his quickly multiplying race should be scattered. O sublime and simple power of the God whom he had forsaken! No earthquake shook the foundation of their tower,—no tornado hurled it from its place,—no pestilence destroyed the haughty workmen,—but 'He confounded their language, that they might not understand one another's speech.' The zealous, the ambitious, the worldly-wise, were suddenly reduced to a state of helplessness, tending to the ridiculous. Their unity of purpose was lost; their orderly plan was brought to confusion, and they left off building the city;—therefore was the place called Babel, 'because the Lord did there confound the language of all the earth, and from thence did the Lord scatter them abroad upon the face of all the earth.' Thus was man's

power of combination in mischief checked, but thus also wa his power of good diminished.

Fourteen centuries rolled away, when again on the same spot did a proud monarch endeavour to counteract the consequences of that early judgment, by commanding all people, nations, and languages, to fall down and worship the golden image he had set up. And many were there of the temper of the men of Babel, ready to unite in a vain-glorious project. But in vain did all the people, the nations, and the languages fall down at the appointed and clamorous signal, that they might thus exalt, not the golden image, but him who set it up —in vain, because certain Jews, of the sons of the captives, regarded not the king and his graven god. The triumph of the lordling was incomplete so long as three men in his wide dominion dared to worship according to their conscience. How often has the cause of truth appeared in this perverted world, in a minority as feeble, and how continually does the confusion which sin has wrought, exhibit itself in the transient elevation and injurious triumphing of the wicked. Even in Babylon, then, there were found three men of one country, willing to peril life for the glory of the living God,—three of the family of Israel, who had so far emerged from the obscurity of a state of bondage, as to be counted worthy of subjugation in this matter. They calmly replied to the threats of the despot, 'If it be so, God whom we serve, is able to deliver us from the burning fiery furnace, and he will deliver us out of thine hand, O king. But if not, be it known unto thee, O king, that we will not serve thy gods, nor worship the golden image which thou hast set up. Then was Nebuchadnezzar full of fury, and the form of his visage was changed.' Hast thou forgotten, O king, the tradition attached to thy city of old? Hast thou no dread of Him who scattered thy predecessors, even the original builders of thy Babel? Wilt thou dare to lay hands on the worshippers of Him, who confounded their language of old? Even so, thou lordly one, for thou seest not by faith the Son of God, who is nigh to all that call on him, and is afflicted in all his people's afflictions. But

'the angel of his presence saved them;' and the persecutor of the three whose meek courage had not forsaken them even in the fire, was made the first to invite them forth of his ingeniously constructed furnace, confessing them to be the servants of the Most High God.

Thus did three men who trusted in God, and changed the king's word, and yielded their bodies that they might not serve nor worship any God except their own, the Eternal and Unchangeable, rebuke the pride of their powerful conqueror, and frustrate his project of uniting once more in one evil object, those whose diversity of language had long estranged them from each other. M. G. L. D.

THIRTEENTH WEEK—MONDAY.

HUMAN LANGUAGE.

One of the most remarkable and important of human acquirements is the use of articulate sounds, without which no very extensive intercourse could have been carried on between man and man, and the progressive improvement of society must have been extremely slow and limited. The lower animals, as has been already observed, have some kind of communications with each other, both by signs, and by the emission of sounds, which constitute a language suited to their nature; but they know nothing of articulate sounds, or what has been called conventional language. This acquirement was reserved for the human race, and forms one of man's remarkable and distinctive characteristics.

But man has a natural language as well as the inferior animals. He instinctively expresses his wants and his passions by signs and by inarticulate sounds. There is, in this respect, an universal language, which, like the language of the inferior creation, requires no instruction to understand. By the features of the face, and the gestures of the body, various emotions can be most significantly communicated. Joy

and sorrow, indignation and pity, surprise, terror, and exultation, with every other powerful feeling of the mind, are thus represented. These signs and gestures are the instantaneous and involuntary effects of passion, and they speak a language which cannot be mistaken.

The instinctive modulations and tones of the human voice form another branch of natural language. These cries are uttered involuntarily even in infancy, and at every period of life they burst forth spontaneously, in spite of all artificial refinements, without design, and even contrary to inclination. They form the nearest approach to articulate sounds; and some of them are even introduced into written language, under the grammatical name of interjections; but yet the difference is marked and specific. The intonations accompanying these sounds, are not, however, confined to them. They are carried into all the utterances of artificial language, and form, in common conversation, as well as in oratory, one of its most interesting and impressive features.

It is obvious that these natural signs might have been sufficient for carrying on a limited intercourse in the rude stages of society; but they could never, even although greatly extended, have answered the purposes of civilized life; and, indeed, society could not have advanced a step beyond these rude stages, without a far more perfect power of communication. For purposes of improvement, man requires not merely to communicate to his fellows his feelings and passions, but ideas of objects, of actions, of relations, of abstract thoughts, of trains of reasoning; and something much more precise and varied than signs was therefore necessary. This essential gift has been bestowed in the power of forming artificial or conventional language.

I have already noticed those properties of the atmosphere which render it a fit vehicle of articulate sounds, as well as the adaptation of the ear for the reception of such sounds, and their conveyance to the mind. I have now to mention an equally remarkable adaptation, in the organs of speech. The windpipe, the tongue, the teeth, the lips, are all admirably formed,

among their other important uses, for this express purpose. Were any one of them made otherwise, some part of that admirable mechanism would be imperfect, which, as at present constituted, forms an instrument of such wonderful power and beauty. We are so accustomed to the human voice, that we are apt to overlook its perfections; and it requires some effort to induce us to attend to the means by which we obtain so familiar, but so delightful and necessary an endowment. But were we to enter into an analysis of the organs of speech, we should find, at every turn, proofs of the most refined and careful contrivance, for rendering the instrument such as might be best employed in conveying the sentiments of a rational creature, equally as regards precision, harmony, and emphasis. It is enough, however, for our present purpose to know, that these effects are actually produced by a complicated combination of mechanical powers, which it has baffled all the resources of human art to imitate.

In the origin of language there seems to exist some obscurity. Much ingenuity has been expended in endeavouring to show that it was entirely the fruit of human invention. But the difficulties with which this supposition is attended are confessedly great; and its most zealous advocates are forced to admit, that language could only have originated in the surpassing genius of some superior minds. The opinion most consistent with the probability is, that the Author of our nature, who bestowed the requisite powers and faculties, also taught the mode of exercising them.

There are two facts which strongly bear on this point; the one is, that wherever, from defects in the organs of hearing, or from seclusion in infancy from human society, no opportunity has been afforded of learning articulate sounds by imitation, the faculty of speech has always been found wanting, except so far as subsequently acquired with labour and perseverance, by instruction from those who have previously practised it; and the other, that in all cases, the actual power of articulation is found to be so much limited to the formation of those sounds only which have been acquired in infancy, that

it is with great difficulty the pronunciation of any new sounds can be attained at a more advanced age. But, independent of this, the succinct narrative which is afforded us in the inspired volume of the state of man in Paradise, seems greatly to favour, if it does not expressly declare, the immediate interference of Heaven to communicate this important instruction; for we are told, that God caused every beast of the field and every fowl of the air to pass in review before Adam, that, by observing their qualities, he might affix to them corresponding names; 'and whatsoever Adam called every living creature, that was the name thereof.' Man was then possessed, even at that earliest period, of the faculty of speech; and its copiousness and precision must have been quickly increased by the salutary exercise which was thus afforded, at once to his mental faculties, and to the power of giving them expression.

Language thus commenced, as philosophy, unaided by revelation, might have conjectured, by giving names to existing objects. The art once learnt, would be easily extended. From noting and expressing in words those things which come under the immediate cognizance of the senses, the mind would proceed to the formation of articulate sounds for conveying the idea of motions and qualities; and thence, again, it would rise to the marking of more abstract notions. A desire would be excited of expressing inward emotions and opinions more definitely than could be done by signs or exclamations. As man had been blessed with a companion of his own species,—that last and best gift of Creative Goodness,—the sympathies thus excited would originate this desire, and he would not be slow to follow its dictates. In the interchange of feelings and views, he would discover a gratification which would enhance tenfold the joys of Paradise, by reflecting them from a kindred bosom; and in this, more perhaps than in any other particular, he would find that it was good for him not to be alone.

Ingenious men have delighted to trace language in its course of development, as the wants, the feelings, and the opinions of men required to be communicated. In such an inquiry

there are few facts on which to rest a train of reasoning, and conjecture has been largely employed to supply their place. It is, however, obvious enough, that the copiousness of language would keep pace with the progress of knowledge, and the expansion of the human mind; and, accordingly, it has, generally speaking, been found, that the fulness, if not the perfection, of a language, is a just criterion of the extent to which mental improvement has been carried among those nations which employ it. But this is a subject on which it is unnecessary to dwell. The possession of the power of speech is a boon for which we cannot be sufficiently thankful. That it is adequate to the expression of all the ideas necessary to be communicated in the ordinary intercourse of society, and capable of expansion in proportion as the range of the human mind extends, are properties which constitute its peculiar value.

Nor must we forget that language has a reflex influence on the mind, in giving a precision to our ideas and reasonings, which they would not otherwise possess; and that it is further of essential value, from the nature of its construction, which has enabled human ingenuity to separate its sounds into their constituent parts, and thus to originate the most beautiful and important of all human inventions,—that of the letters of the alphabet. Hence the origin and transmission of history, of literature, of the arts and sciences; hence the accumulation of human knowledge, and the indefinite improvement of the human species, rendered more rapid and more secure by the modern invention of the art of printing. The stimulus already given to the mental powers, and the effects produced by that stimulus, we can partly compute; but who can anticipate the changes which these acquisitions are yet destined to produce? It is a tremendous power which is thus put into the hands of mortals. Let us rejoice that it is under the control of a Being infinitely wiser and better than the race of Adam; and that, along with the works of fallible man, is transmitted an Inspired Volume, which has the Creator and Redeemer for its theme, truth without any mixture of error for its matter and life and immortality for its object.

THIRTEENTH WEEK—TUESDAY.

HAY-MAKING.—PLEASURES OF RURAL SCENERY.

I BELIEVE few people have beheld the occupations of the hay field, which this beautiful season every where presents, without feeling a very pure and elevated delight. The mowers moving gracefully in concert, the grass falling sheer beneath the scythe, its grateful fragrance, the maidens raking or tedding the hay, the loading of the carts to remove it to the barn-yard, all excite a sensible pleasure in almost every mind.

> 'Wide flies the tedded grain. All in a row,
> Advancing broad, or wheeling round the field,
> They spread the breathing harvest to the sun,
> That throws refreshful round a rural smell;
> Or, as they rake the green appearing ground,
> And drive the dusky wave along the mead,
> The russet hay-cock rises thick behind,
> In order gay; while, heard from dale to dale,
> Waking the breeze, resounds the blended voice
> Of happy labour, love, and social glee.'
>
> THOMSON.

Whence arises the enjoyment which this rural occupation calls forth, both in the bystander, and those who are engaged in it? It seems almost entirely the result of association. Something, indeed, may be attributed to the mere animal pleasure of a healthy employment in the open air, while breezes, freighted with sweet odours, breathe softly, and shed their salubrious influence around; and there may also be a pleasure of taste arising from the swinging motion of the mowers, moving as if actuated by one common impulse; but if we consider the matter calmly and discriminately, we shall find that by far the deepest and most exhilerating sense of the emotion, lies in suggestions and feelings chiefly of a moral and benevolent kind. Mental operations are so recondite, and the seat and moving cause of inward emotion is so mysterious, that, when we attempt to analyze, we may, in our

ignorance, overlook some important element; but undoubtedly a chief part of our enjoyment arises from a secret sentiment of sympathy. A concerted movement implies a common will; and this, of itself, excites an agreeable sensation in the mind, when that will is directed to some useful object. The pleasure, too, arising from a scheme of utility successfully completed, is another moral element that enters into the feeling. The farmer has sown in hope, he is now reaping in joy, and we feel a sentiment of congratulation, even where we have no opportunity of expressing it. We place ourselves in his situation, and shadow forth to our imaginations what he must feel at this consummation of his labours and anxieties. That this is a very principal part of our enjoyment, will appear obvious, if we only consider, that the feeling is much enhanced by the luxuriance of the crop, and the favourable nature of the weather. Let any man fancy to himself, what would be his sensations, were he to see the very same operation going forward in a field overgrown with weeds, or where the hay was stinted in its growth, or withered by the drought; or if he saw the mowers plying their task, for some cause or other, in the midst of a storm; yet the movements are the same; the associations only are changed.

The very same observations may be applied to the other labours of the hay field. It is the pleasure of sympathy, an excitement of the benevolent feeling in our breast; and it is a wise arrangement of our Creator, that all rural occupations, prosperously carried on, are attended with a similar feeling. It not only increases the sum of our enjoyments, but, in a very salutary manner, exercises the social virtues.

Mr. Alison, in his work on the 'Principles of Taste,' extends this view even to rural scenery. 'A common English landscape,' says he, 'green meadows, with cattle, canals, or navigable rivers; well fenced, well cultivated fields; neat, clean, scattered cottages; humble antique churches, with church-yard elms, and crossing hedge-rows, all seen under bright skies, and in good weather;—there is much beauty, as every one will allow, in such a scene. But in what does

the beauty consist? Not certainly in the mere mixture of colours and forms; for colours more pleasing, and lines more graceful (according to any theory of grace that may be preferred), might be spread upon a board or a painter's pallet, without engaging the eye to a second glance, or raising the least emotion in the mind; but, in the picture of human happiness that is presented to our imaginations and affections, in the visible and unequivocal signs of comfort, and cheerful and peaceful enjoyment, and of that secure and successful industry which insures its continuance, and of the piety with which it is exalted, and the simplicity by which it is contrasted with the guilt and the fever of a city life; in the images of health, and temperance, and plenty which it exhibits to every eye, and the glimpses which it affords to warmer imaginations, of those primitive or fabulous times, when man was uncorrupted by luxury and ambition, and of those humble retreats in which we still delight to imagine that love and philosophy may find an unpolluted asylum.'

There is much good feeling as well as sound philosophy in this view, although there may perhaps be a somewhat undue but excusable leaning to the author's own peculiar theory. The beauty and general truth of the sentiment that follows, cannot fail to strike every mind, whether the philosophical view which it is intended to establish be adopted or not. 'At all events, however, it is human feeling that excites our sympathy, and forms the object of our emotions. It is man that we see in the beauties of the earth which he inhabits; or, if a more sensitive and extensive sympathy connect us with the lower families of animated nature, and make us rejoice with the lambs that bleat on the uplands, or the cattle that ruminate in the valley, or even with the living plants that drink the bright sun and the balmy air, it is still the idea of enjoyment,--of feelings that animate the existence of sentient beings, that calls forth all our emotions, and is the parent of all that beauty with which we invest the objects of the inanimate creation around us.'

Without determining whether or not there may be too

much exclusiveness in this view of the origin of a sense of the beautiful, I shall add that there is here a foundation for a deep and enlightened devotional sentiment. While our sympathies go forth towards our fellow mortals, in the contemplation of the objects with which we are surrounded, we have but to take another step to connect this feeling with the the Author of all that interests our affections, and calls forth our emotions. Such, indeed, is the habitual feeling of the pious mind. He sees God in every thing; and, whenever his heart overflows with pleasure, it rises in gratitude and admiration to the Source of all pleasure,—his taste acquiring new expansion, his sentiments additional force and elevation, and his enjoyments a warmer and brighter glow.

THIRTEENTH WEEK—WEDNESDAY.

THE VARIETY, BEAUTY, AND UTILITY OF ORGANIZED EXISTENCES.

The variety which characterizes nature is very striking and never appears so remarkable as during the full flush of summer, when organized life is in its greatest vigour. The beautiful undulations on the surface of the earth, which exhibit every where new scenery, and delight us with their graceful outline and contrasted figure and shades, form a fitting groundwork for the varied productions which that surface contains. If we turn our eye to the vegetable kingdom, how numerous and how varied in form and qualities are the plants with which we are surrounded, and what diversities in their colours, their size, and their odours! From the humble moss to the stately oak there is a continual change of properties and of shapes, which seems to indicate variety as one of the prime intentions of the Creator; and yet, along with this variety, there is a constant reference to a general type. Although in every order and class these are specific differences, and in the various species of each class these differences are prodigiously multiplied, yet among them all there

is a peculiar character which marks vegetable nature, and from that character there are no deviations.

The very same thing may be said of animal life. There are not fewer varieties in this department than in the former; and here, too, there is a particular type from which nature does not deviate. There may, in truth, be said to be only two types among organized beings, the vegetable and the animal; and even these have their analogies and correspondences which invest them with a similar character, and mark them with the impress of the same Almighty hand. But, within the limits which the Creator has assigned to himself, the variety is indeed amazing. It seems as if all forms, all properties, and all modes of existence were exhausted. Not only is there an immense diversity in the orders and families, but that diversity extends to individuals, so that it has been said, with great probability, that in the myriads of leaves belonging to the same tree, or to all the trees of the forest, it is impossible to find two in all particulars perfectly alike.

There is much wisdom and goodness in this sameness, combined with diversity. It is in fact the foundation of our knowledge of natural objects. Were there no plan in nature, there could be no generalization; were there no diversity, there could be no individual distinctions. It cannot be said that this arrangement was necessary. It is easy to conceive a world formed altogether on a different scheme, or even without any scheme at all. That there is a distinct and harmonious system, implies intelligence; that it is diversified, implies some specific intention. What that intention is may be inferred from other considerations.

There is beauty in this diversity. That is to say, the human mind is so constituted as to derive enjoyment from the particular forms and combinations which nature exhibits. It may be difficult to determine in what the idea of beauty consists. This is a subject which has occupied the ingenuity of speculative minds, and given rise to different theories of taste: but on whatever principles of our nature it depends, the fact is the same. There is nothing in the general aspect

or circumstances of the objects with which we are surrounded to excite disagreeable sensations. Sometimes, indeed, the eye may be shocked, or the ear grated, or the sense of touch, of smell, or of taste offended; but these are rare exceptions, just sufficient to show us how miserable we might have been rendered had nature been constituted otherwise. The adaptation of our perception of beauty to actual appearances is therefore a most beneficent provision.

The nature and extent of this adaptation are under no circumstances more observable than during the revolution of the summer months. What loveliness is abroad in the earth, the sea, and the sky! The morning-dawn bursting from the womb of darkness, the full splendour of noon, the softened charms of sunset and the evening twilight, and the glories of night which lights its thousand lamps,—what are these but so many indications of Divine beneficence? The balmy softness of the air, the ever-changing curtain of the floating clouds gracefully drawn over the sky to mitigate the excessive fervour, with the refreshing coolness of the shade and the gentle breeze, speak the same language. The flowers that enamel the meadows, graceful in their form, lovely in their harmonizing hues, and grateful in the sweetness of their perfume; the herbage in its various kinds; the bushy shrubs; the majestic trees, differing in size, in shape, and in shade; the living world in all its diversities—the trout leaping from the pool, the busy insect fluttering in the sunbeam or moving across our path, the bird with its painted wing and sweet song, the domestic herds and flocks quietly grazing on hill or dale, the beasts of the forest which occasionally start from bush or brake,—each and all seem formed to fill the mind with agreeable sensations, and to raise it in adoration to the Giver of all good.

'Everywhere,' says the pious Sturm, 'nature works to procure us new enjoyments—even the smallest insects, leaves, and grains of sand, offer subjects of admiration. The same brook that waters the valleys, murmurs sweet music to our ear, invites us to soft repose, and refreshes the parched tongue.

The grove, which shields us from the piercing rays of the sun by its protecting shade, makes us experience a delicious coolness. The trees, whose beautiful blossoms so lately delighted us, will soon produce the most agreeable fruits; and the fields, waving with the ripening corn, promise an abundant harvest. Nature presents us with no objects pleasing and useful only in one respect. She clothes and adorns the earth with green, a colour most beneficial and agreeable to the eye, and adds to its beauty by diversifying its shades; for, though pleasing in itself, its charms are much increased by this happy distribution of shade. Each species of plant has its peculiar colour; landscapes covered with wood, bushes, plants, herbs, and corn, present a most beautiful scene of verdure, where the colouring is infinitely varied, and its shades insensibly blended, increasing from the lightest tints to the darkest hue, and yet a perfect harmony is always preserved.'

But what is chiefly to be observed and admired in the diversities of nature, is the adaptation of everything to some particular use, and of all to the completeness of the whole system. There is nothing isolated, nothing useless. The two divisions of organized existence are formed for each other. Every plant has some corresponding tribe or tribes of animals which it supports, and to whose properties and modes of existence it is peculiarly adapted; if there are succulent leaves, there are caterpillars to feed on them; if there are flowers which secrete honey, there are bees and other insects to sip the sweets; if there are fruits, there are birds to feast upon them; if there is herbage, there are cattle to crop it; and if there is death, there are living beings which convert even this to the support of life by devouring the inanimate carcass.

There is here a complicated and most wonderful system; and this system is so nicely balanced, as I have elsewhere shown, that every part is preserved in its due proportion, and one species contributes to the benefit of all. It is, however, to man especially that this system bears reference. We have seen, in the course of our inquiry, how wonderfully every thing is suited to his use, and with what ease he is enabled

to control and modify Nature in all its varieties, so as to accommodate it to his necessities, and cause it to contribute to his comfort and prosperity. This is not the result of his own ingenuity, but of a scheme of infinite wisdom and beneficence planned for his benefit, and destined for the development of his faculties, and the discipline of his moral powers.

THIRTEENTH WEEK—THURSDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—ADAPTATION.

THE great object of the present volume has been to consider the attributes of the Creator, as these are displayed in the full development of the qualities, powers, and faculties of natural objects, whether animate or inanimate. We have seen that these are all united together in a system marked with some very peculiar characteristics, the leading features of which, so far as these relate to organized beings, are growth, maturity, decay, death, and reproduction. To these conditions, whatever be their ultimate object, we find the whole scheme of sublunary things to be adapted. Their necessary concomitants are change, privation, infirmity, and pain. Without, at present, recurring to the religious view of the question, which amply vindicates this system, by communicating to us those ultimate ends which revelation alone could unfold, let us look back on the ground we have traversed, that we may concentrate our argument, and see in what manner, under the restrictions we have mentioned, the power, wisdom, and goodness of the Creator have been established.

In the commencement of the 'Winter' volume, I laid down two great principles as the objects of inquiry, namely, *contrivance* to avoid evils or to obtain advantages; and *compensation* for evils actually permitted or appointed. In the course of these volumes that inquiry has been prosecuted at length, and it may surely now be maintained that a system of such

contrivance and compensation has been established by a superabundance of proof, and that thus the existence of a Being of pre-eminent wisdom and benevolence has been irrefragably demonstrated.

There is a view of the Divine operations as displayed in creation, partly differing from both of these, yet in some measure including them both, which has also been pointed out, and, I trust, distinctly proved; I mean that which exhibits the scheme of the Creator, as a system of *adaptation to certain conditions;*—the contrivances and compensations being all so adjusted as to form a consistent whole, in which the various parts bear relation to each other, and conspire and harmonize in promoting one important end. We have an example of this in the sun,—the source of light and heat,—and in the various elements of which the atmosphere and the soil are composed, which all unite their powers and qualities in nourishing vegetable and animal life; or, taking the converse view, we find this principle exemplified in the beautiful and skilful adjustment of the properties of vegetable and animal life, to the influence of the soil, the sun, and the elements. The same thing may be said of the relation which subsists between the vegetable and animal worlds themselves, and between the various species which exist in both of these departments. It is a relation of adaptation. Plants are made for living beings, and living beings for plants. Between them, and among each other, there is the most marked and admirable adjustment, always bearing reference to the five pervading conditions already mentioned, of growth, maturity, decay, death, and reproduction.

As our mundane system, therefore, is all relative, the most striking way, perhaps, of exhibiting its perfection, is to make a supposition of some alteration taking place in any one of its relations. We shall uniformly find that a derangement in the system would immediately take place; that what in itself might appear to be an improvement, would, in reference to the whole scheme, prove to be the very reverse; and that, in order to accommodate other properties or existences to that

one change, the most extensive changes would be necessary, branching out into interminable relations, till the mind would be lost in the pursuit of consequences.

There are some striking examples of the incongruity of such imagined alterations in St Pierre's Studies of Nature, and instead of seeking for them myself,—which were easy, for they are to be found every where,—I prefer making use of the speculations of that delightful, though sometimes too imaginative writer. 'For example,' says he, 'complaints are made of death; but if men were not to die, what would become of their posterity? Long before now there would not have been room for them on the face of the earth. Death, therefore, is a benefit.—Men complain of the necessity of labouring; but unless they laboured, how could they pass their time? The reputedly happy of the age, those who have nothing to do, are at a loss how to employ it. Labour, therefore, is a benefit.—Men envy the beasts the instincts which guide them; but if, from their birth, they knew, like them, all that they are ever to know, what should they do in the world? They would saunter through it without interest, and without curiosity.

'The other ills of Nature are equally necessary. Pain of body and vexation of spirit, which so frequently cross the path of life, are barriers erected by the hand of Nature, to prevent our deviating from her laws. But for pain, bodies would be broken to pieces by every shock; but for distress, so frequently the companion of our enjoyments, the mind would become the victim of every sickly appetite. Diseases are the efforts of temperament to purge off some noxious humour. Nature employs disease, not to destroy the body, but to preserve it. In every case it is the consequence of some violation of her laws, physical or moral. The remedy is frequently obtained by leaving her to act in her own way. The regimen of aliments restores the health of our body, and mental regimen tranquillity of mind. Whatever be the opinions which disturb our repose in society, they almost always vanish into air in solitude. Sleep simply, and of it

self, dispels our chagrin more gently and more infallibly than a book of morals. If our distresses are immoveable, and such as break our rest, they may be mitigated by having recourse to God. Here is the central point, to which all the paths of human life converge. Prosperity, at all seasons, invites us to His presence, but adversity leaves us no choice. It is the means which God employs to force us to take refuge in himself alone. But for this voice, which addresses itself to every one of us, we should soon forget Him, especially in the tumult of great cities, where so many fleeting interests clash with those which are eternal, and where so many *second* causes swallow up all attention to the FIRST.'*

THIRTEENTH WEEK—FRIDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—FUTURE EXISTENCE.

IN the previous paper it has been shown, that the system of creation is perfect in its relations, insomuch, that were any of its circumstances to be altered, far greater inconveniences than actually exist would necessarily ensue; or, in other words, that, taking the general scheme as we find it, the evils which result from it are at the *minimum*, and the advantages at the *maximum*. But still the question recurs, is the system itself wise and beneficent? In this inquiry there is much more difficulty than in the other; and, in order to answer it, we must have clear views of the ultimate object and intentions of the Creator. It is an inquiry which the natural philosopher has often blinked, and on which he has never successfully entered without the aid of Revelation. There are, however, some views apparently forced on the inquiring mind by nature itself, which seem to open a glimpse of the truth.

The first thing that naturally occurs to a philosopher ex-

* Study viii.

amining this sublunary system by the light of nature alone, is, that there is a certain want of adaptation between the human mind and the world in which it exists; that, while every thing else is most strictly and wisely adapted to its situation and circumstances, man, the chief of earthly existences, is a remarkable exception. This is, to a certain extent, true of our natural wants:—'There exists not a single animal,' St Pierre justly remarks, 'but what is lodged, clothed, fed by the hand of Nature, without care, and almost without labour. Man alone, from his birth upward, is overwhelmed with calamity. First, he is born naked, and possessed of so little instinct, that if the mother who bare him were not to rear him for several years, he would perish of hunger, of heat, or of cold. He knows nothing but from the experience of his parents. They are under the necessity of finding him a place where to lodge, of weaving garments for him, of providing his food for eight or ten years. Whatever encomiums may have been passed on certain countries for their fertility, and the mildness of their climate, I know of no one in which subsistence of the simplest kind does not cost man both solicitude and labour.'*

There are, doubtless, compensations for all these inconveniences, but they are such as prove incontestably that man is in a state of discipline,—that there is a studied plan to develope and exercise the powers and faculties of his mind. And for what? If this plan refer merely to a present life, so far as happiness and moral worth are concerned, it fails of its object. 'When man has collected around him,' observes the same author, 'every thing necessary to a quiet and comfortable life, ambition, jealousy, avarice, gluttony, incontinency, or languor, takes possession of his heart. He perishes almost always the victim of his own passions.' This is but too true of those who have no higher object than the gratification of their senses. Meanwhile, indeed, their intellectual faculties are cultivated and expanded; but to what purpose, if they

* Study viii.

are to go down to the grave, and be 'as if they had never been ?'

If there be a future state of existence, the difficulty is solved; for in that case new and nobler motives of action are presented to the mind,—a regulating principle is introduced, which, like a skilful pilot, steers the bark to its destined port. We are no longer left to the mercy of the winds and waves, soon to perish miserably; but with our charts in our hands, we ply steadily forwards in spite of opposing storms and currents; courting every favourite breeze; assiduously avoiding adverse gales or currents, or even skilfully employing these to aid us in our course; and only at ease when we find ourselves making progress towards the consummation of all our anxieties and toils. The doctrine of future existence, then, is necessary to render our situation in this world intelligible; and the hope which it inspires, is of essential importance for the useful regulation of our lives.

It is from the nature of the human mind, itself, however, rather than from external circumstances, that we derive the strongest argument of unassisted reason for the doctrine of immortality. Its powers and faculties are superior to its present condition. The objects with which it is conversant are not capable of affording it solid and permanent satisfaction. It is susceptible of indefinite improvement; but there is no sublunary pursuit sufficiently enlarged to occupy it, or sufficiently valuable to constitute its happiness. It is always aspiring, and never content. As its powers expand, they only become more unsuitable to its circumstances; and the more pleasures it is capable of enjoying, and the greater the range of knowledge it is able to grasp, the more deeply does it feel how inadequate are the things of earth to its gratification. This want of adaptation is totally unlike what takes place in other things. It is an anomaly of which Nature herself teaches us to inquire the cause.—We find this cause only in a future existence.

There is yet another consideration, arising from this view of the indefinite improvement of the human soul. It seems

altogether inconsistent with the uniform analogy of nature that such a being should perish. Other animals possess just such faculties and instincts as fit them for the situation in which they are placed, and no more. As there is nothing wanting to them, so there is nothing superfluous. But it is otherwise with man, if his soul is to be dissolved along with his body. Its qualities, capable of unlimited expansion, shall then have been created in vain. They have only begun to exist; shall they be nipped in the bud? An interminable career is before them; shall they be arrested when the race is but just commenced? There is an intellect to cultivate, a moral faculty to exercise, duties to perform, and aspirations and hopes to cherish; have all these qualities and views been implanted to be suddenly quenched in nothingness? If so, then the analogy of nature is broken, and the noblest of the Creator's mundane works is an abortion.

These are the most powerful arguments by which, on the principles of reason, the immortality of the human soul has been maintained. He who has attended to the bearing of the facts which have been adduced in the course of our inquiry, will be best able to appreciate their force. If he is satisfied that in all other particulars the adaptations are complete, and that here only they fail, he will probably see reason to conclude, that this remarkable anomaly must be owing to the connexion of the human race with another system; and while in this he discovers an argument to prove the solid foundation of those future expectations which rise unbidden in his heart, and seem to be an instinct of his nature, he will at the same time perceive a new light cast on the whole system of creation. Man is in a state of preparation for a higher destiny. The world is formed to prepare him for that destiny. He is in the school of Providence, educating for immortality. The situation and circumstances of inferior existences, while they are suitable to their condition, are peculiarly and above all, contrived for this object, and, with reference to him, are the means to that end. And here, again, there

is the most consummate skill, the most comprehensive benevolence, the most refined adaptation!

These are, at least, plausible conjectures, but they are not demonstration. Let us rejoice that they are confirmed and rendered as certain as the existence of the Eternal himself, by him who has 'brought life and immortality to light by his gospel.'

THIRTEENTH WEEK—SATURDAY.

RETROSPECTIVE VIEW OF THE ARGUMENT.—DISCIPLINE.

When we become assured of the fact, that man is destined for immortality, all the difficulties which a view of Nature, as a state of change and decay, presented to the mind, are removed or diminished, and we come to see more clearly how the disorders which seem to prevail in the world, may be reconciled to the Divine perfections.

I have already adverted to this subject, and placed it in various aspects. At present, my object is to bring the question of discipline into one point of view, and to show its bearing on the conditions and operations of external nature. Fatal experience proves that the human mind, as regards its moral faculties, is in such a state of disorder, that the ordinary events of life do not affect it in a salutary manner. Under the influence both of prosperity and adversity, as well as under alternate vicissitudes in our condition, the heart may remain unimproved. It may indeed be hardened and deteriorated by every change of fortune, and by every permanent state in which the events of life may place it. When surrounded with all the means of gratification, it may become selfish and worldly; when in circumstances of privation and suffering, it may be rendered peevish, disheartened, and discontented; when visited with alternate sunshine and gloom, selfish cares and anxieties may only gather the thicker around it.

It is not, then, in the mere circumstances of life that we are to look for the moral improvement of the human character. It is true, as has already been shown, that every thing seems naturally designed, and admirably contrived, for urging forward the *intellectual* improvement of man, and, in this respect, the system of discipline may be considered complete; but it is not so, as regards his *morals.* Here peculiarly lies the taint of the fall; and, what is asleep must be awakened,—what is dead must be revived,—the Divine image, which erewhile animated the soul, must be restored,—before apostate man can be in a fit condition to profit by the moral discipline provided for him.

The means of this renovation, however, are placed within his reach, and the disciple of Him who died for sinners, is freely invited to ask, that he may receive. The way is open, and cannot be mistaken; for it is traced by the blood of his Redeemer. To such a man, the world is a state of moral discipline, every way suitable to his condition. God is his Father, whose eye watches over him; whose hand supplies his necessary food; whose Book instructs him; whose smile cheers and encourages, whose frown awes, whose rod corrects him.

In this view, nothing can be more admirable than the adaptations of external nature to his situation. He is a child of a family, early trained under the tender eye of a mother; and supported, during the helpless years of infancy, by the means provided for him by an affectionate father; and, in his brothers and sisters, associated with companions and equals, who are bound together by a common lot. He thus early learns to bend to the yoke of authority; to be dependant and humble; to be docile, dutiful, and affectionate. His filial reverence, his fraternal love, his sense of duty, are thus called forth and cultivated; and all this domestic training prepares him for cherishing the still nobler principles of religious obedience and submission, and the more exalted sentiments of pious gratitude, veneration, and confidence.

In a more extended intercourse with his fellows, the Chris-

tian finds new opportunities of cultivating his virtues and graces. When he comes into collision with the bad passions and evil practices of those with whom he is conversant, he sees, as in a mirror, his own heart reflected, and he learns to be diffident, watchful, and charitable. When he meets with men of congenial minds, who serve the same Divine Master, and are animated with the same blessed hopes, his heart glows with a kindred flame, and mutual sympathy forms his solace and his strength. When the world prospers with him, he blesses the Giver of all good, and, remembering that he must give an account of his stewardship, exercises himself 'to have a conscience void of offence towards God and towards men.' When affliction comes, he receives it as the chastisement of a Father, who chastens him for his profit; when death snatches a friend or partner from his bosom, he feels indeed that the lesson is severe, but he hesitates not to learn it; and in the resignation of his heart he exclaims, 'The Lord giveth and the Lord taketh away, blessed be the name of the Lord.'

If, in this spirit a man engage in the various duties, and exercise the numerous relations, of life, he finds that all the tendencies of his intercourse both with the animate and inanimate world, lie in the same direction. All are full of instruction, and wisely adapted to train him for immortality. He

> 'Finds tongues in trees, books in the running brooks,
> Sermons in stones, and good in every thing.'

It is true, indeed, that this effect is only partial. It proceeds but a certain length, and then stops short. While it presents heaven to our view, it still keeps us lingering among the things of earth; while it cherishes celestial graces, and fills the mind with high anticipations, the very objects, by which these views and feelings are impressed, themselves claim part of our hearts, and bind us by strong ties to the world, of which they teach us the vanity:—And this also is a beneficent provision. We cannot bear that heaven should be fully unveiled to us, while we remain denizens of earth. Such a vision would totally unfit us for our present station,

and our present duties. An incident, mentioned by the eloquent author I have lately quoted more than once, will illustrate this. 'I recollect that, on my return to France, in a vessel which had been on a voyage to India, as soon as the sailors had perfectly distinguished the land of their native country, they became, in a great measure, incapable of attending to the business of the ship. Some looked at it wistfully, without the power of minding any other object; others dressed themselves in their best clothes, as if they had been going that moment to disembark; some talked to themselves, and others wept. As we approached, the disorder of their mind increased. As they had been absent several years, there was no end to their admiration of the verdure of the hills, of the foliage of the trees, and even of the rocks which skirted the shore, covered over with seaweeds and mosses; as if all these objects had been perfectly new to them. The church-spires of the villages where they were born, which they distinguished at a distance up the country, and which they named one after another, filled them with transports of delight. But when the vessel entered the port, and when they saw on the quays their friends, their fathers, their mothers, their wives, and their children, stretching out their arms to them with tears of joy, and calling them by their names, it was no longer possible to retain a single man on board; they all sprang ashore, and it became necessary, according to the custom of the port to employ another set of mariners to bring the vessel to her moorings.'*

There is an appearance of some high colouring in this picture; but it serves well to illustrate the view I am considering. There cannot be a doubt, that, were it not for the natural obtuseness of our mental vision in contemplating spiritual things, and the difficulty of realizing them to our understanding and our affections, the truths revealed to us in Scripture would make so deep an impression in our hearts, as to unfit us for the ordinary business of life. The world, with

* Studies of Nature, vol. ii. p. 289.

all its duties and all its ties, would appear 'weary, stale, and unprofitable;' its affairs would come to a stand, and irrepressible longings to join the blessed throng, among whom some of the most fondly and deeply cherished friends of our hearts are mingled, would occupy the place of all sublunary things. If this world was to remain a place of discipline and of duty, it was necessary that heaven should continue veiled in the dim obscurity of distant and misty perspective, and that the spiritual should only be seen by reflection, as it were, from the material world.

FOURTEENTH WEEK—SUNDAY.

DAY OF PENTECOST.—ONE LANGUAGE.

The world had existed upwards of two thousand years, before the perverseness of the human race provoked the Creator to introduce the confusion of tongues, which was not only the means of scattering men of the same city, but yrobably, also, caused the disruption of the dearest family ties, and rendered parents and brethren aliens from each other. Century after century elapsed, and the idolatrous families, in their varied tongues, pursued their devious systems of folly in remote regions; and to them it might seem as if God took no account of the condition of his creatures. But with one people was the knowledge of the true God preserved, and in their language were those lively oracles written, which shall convey to man a view of the Divine character and requirements, even till time shall be no more.

Two thousand years again fleeted away after the memorable dispersion of Babel, when at last 'The Promised' and 'The Sent,' fulfilled the burden of a thousand prophecies, and he who had walked in the midst of the furnace on the plain of Dura, manifested himself in mortal mould. While he tabernacled in the world, and exemplified the perfection of which man, when guided by the Divine Spirit, is capable, he had

sent out seventy, endued with many miraculous gifts, so tha themselves were filled with wonder, and rejoiced that even the evil spirits were subject to them. But still they were acquainted with only one tongue,—a vitiated dialect of the Hebrew, so that, whatever were their spiritual gifts, there was an obstacle which they encountered, in the very outset, to the fulfilment of their Master's parting command, to preach the gospel to every creature, and to teach all nations. Here then, when the judgment of Babel, which resigned men to the idolatry they chose, by the loss of the language in which alone God was spoken of and preached, seemed about to be taken off, and all nations were to be invited to unite in believing the Gospel, that judgment, in its practical effect, presented a difficulty which mere human study might not surmount. 'But, as Dr. Lightfoot remarks, 'one dividing of tongues was the casting off of the heathen, and another dividing of tongues restored the knowledge of God to the nations.' Christ sends not his messengers a warfare at their own charges; he passed over the tedious process of study on their behalf, and fulfilled to them his word, 'greater works than these shall ye do.' Having himself passed from them and entered into the heavens, there to remain till the restitution of all things, he sent them the Comforter whom he had promised. 'They were filled with the Holy Ghost, and began to speak with other tongues, as the spirit gave them utterance.'

By this means were signs and wonders wrought, the holy name of the Redeemer exalted, the Gospel preached to men of divers languages, and thousands added to the church But again this gift is withdrawn. It has appeared to give us a hint, on which our minds found a hope of what may be the Divine purpose in reference to the world hereafter, and an exhibition of the power by which present obstacles shall be set aside. It is the opinion of Archbishop Tillotson, that if the conversion of the heathen 'were now sincerely and vigorously set about by men of honest mind, God would extraordinarily countenance such an attempt with all fitting assistance, as he did the first publication of the Gospel.' If this infers an

expectation of miraculous interference, we know not how far it may be consistent with the mysterious decrees of heaven. The nature of one of the difficulties the poor missionary knows right well, as he consumes life with the tardy operation of translating with his interpreter by his side, and announces to the watching Christians in Europe, how he has achieved the gospel by John, or added to it a selection from some other gospel, or from the book of Psalms. But the degree of sincerity, or vigour, or concord required, before we become fitted to receive such aid as Tillotson hints at, we do not know; nor do we know that a departure from the ordinary means of grace will, under any circumstances, be necessary. Were we to venture a conjecture, we would say it is *concord* which is lacking in this mighty affair. We do not observe, with sufficient depth of conviction, the promise to those who are '*agreed* as touching what they shall ask.' We do not mark the manner and times when 'the kingdom of heaven has been taken by violence,' and the Hearer of prayer has been as it were constrained,—but willingly constrained,—to bestow immediate and distinct answers.

When the gift of tongues was bestowed, the disciples were all, *with one accord*, in one place. There was no strife about which should be greatest; none of those divisions which occasionally existed during the time the Lord sojourned amongst them. They had obtained a partial bestowment of the Holy Spirit, and had learned to pray more, and consequently to love each other more. *They* were thus prepared to receive the full effusion of the Holy Ghost. And so must *we* be prepared. The solitary efforts of our various churches are enfeebled, not by their solitude, so much as by the absence of the uniting love, which shall bring down the accomplishment of the promises that all long for. 'That glorious day will teach men to cease from Paul and Apollos, and to feel that Christ is not divided. 'Then shall the heart of the rash understand knowledge, and the tongue of the stammerers shall be ready to speak plainly.' Then shall Zion be a quiet habitation, a tabernacle that shall not be taken down. But there

the glorious Lord will be unto us a place of broad rivers and streams. The Lord will then be our judge, the Lord our lawgiver, the Lord our king; He will save us.

Of all modern efforts to overcome the difficulty presented by diversity of language, the Bible Society is that which has accomplished the most, and encourages the hope, that the Head of the Church will bless the endeavours of human industry and ingenuity. And since the Reformation, which broke down the wall,—the dead, blank wall, without a loop-hole,—which Popery had erected between the Scriptures and those for whom they were written, no scheme has been found so well calculated to shed the light of truth into all regions. The poor dispersed of Israel have now, by the zeal of that society, the history of the Messiah presented to them in their ancient Hebrew. And the islands far off, whose tongues till lately were reduced to no order, are taught to sing his praise. Blessed be his name for this day of small things, and blessed be they whose hearts he hath inclined to unite in this work! But still, is he not suffering our puny efforts for a time, to come forth upon us with the glorious contrast of his finished work? Will he not presently accomplish in his strength what his people have essayed in their weakness? And when, again, he baptizes the nations with the Holy Ghost as with fire, will he not take away the unknown tongue? And shall not utterance be given to all, the curse of Babel be removed, and Jew and Gentile, bond and free, glorify his name together? Then at last shall not men of all nations speak his praises in everlasting songs, and their ears rejoice to hear that which was committed only to the ear of John in his vision in the Isle of Patmos,—the united voice of every creature exclaiming, 'Blessing, honour, glory, and power be unto him that sitteth upon the throne, and to the Lamb for ever and ever?'

Their voice and language shall be one,
Before the throne of God,
And no *confusion* shall be known,
In that divine abode.

M. G. L. D.

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